XVI. *An Account of the Measurement of an Arc of the Meridian, extending from Dunnose, in the Isle of Wight, Latitude 50° 37′ 8″, to Clifton, in Yorkshire, Latitude 53° 27′ 31″, in course of the Operations carried on for the Trigonometrical Survey of England, in the Years* 1800, 1801, *and* 1802. *By Major* William Mudge, *of the Royal Artillery, F. R. S.*

Read June 23, 1803.

SECTION FIRST.

In the last account presented to the Royal Society, I expressed my intentions of making the operations which were to follow that period, subservient to the purpose of measuring a portion of the meridional arc, running from Dunnose, in the Isle of Wight, into the northern part of Yorkshire. In the account referred to, (See Phil. Trans. for 1800, page 565,) I stated my reasons for adopting that resolution, and my hopes that Mr. Ramsden would shortly finish the zenith sector which his Grace the Duke of Richmond had bespoken of him, when Master General of the Ordnance. As that celebrated artist, from the beginning of the year 1800 till the middle of the following summer, had proceeded with little interruption, except from illness, towards its completion, the whole was brought so near to a conclusion before he died, that Mr. Berge found no difficulty in rendering it sufficiently perfect.

It is proper I should state, more fully than I have formerly

done, my reasons for selecting Dunnose as one of the extremities of my meridional line, and also those for preferring its meridian to any other; which I shall do as briefly as possible.

In a country whose surface, throughout its whole extent, is equally diversified with hilly ground, that particular part of it should be chosen, for carrying on a meridional measurement, which comprehends the most extensive arc. This arises from the necessary consequence which attends an operation in a country so circumstanced; as, possibly, no spot fixed on for a place of observation, could be supposed free from the effects of the unequal attraction in the adjoining matter. In such a country, therefore, a measurement upon the most extensive arc, must give the most accurate conclusion; for the errors arising from the cause here mentioned, like those of observation, lessen in their effects, on their application to arcs of increasing magnitude.

If Great Britain were a country thus diversified, the most eligible part would be that where the meridian from Lyme, in Dorsetshire, passes northward into Scotland. The difference of latitude between that place and Aberdeen, near to which that line cuts its parallel, is $4^{\circ}\ 47'$, nearly. But, however great the advantages attending such a length of arc might be, under the general circumstances of accurate terrestrial measurement, and accurate observations at its extremities, no beneficial consequences could be expected to attend the placing of the sector at intermediate stations; as the arc would be found running, almost every where, through a country abounding with hills, considerable both in magnitude and number.

Under this consideration, I determined to measure a portion of the meridian which proceeds from Dunnose to the mouth of the Tees; because, from inquiry, I had reason to suppose it the

longest meridional arc in Britain, free from any apparent obstruction. And I was led to select Dunnose for one of its extremities, as observations made there, in conjunction with others at Greenwich, would enable me to make corrections of the latitudes of places given in our former papers, if found necessary. By fixing on Dunnose, I had also the means of ascertaining the distance of the Royal Observatory from the northern or southern end of my line, and, consequently, of connecting it with the parallels of Dunkirk and Paris.

Dunnose being fixed on, my subsequent endeavours were directed towards carrying on the triangles, as nearly as I possibly could, in the direction of its meridian, selecting the stations so that their sides might be properly inclined to it, and of sufficient length. In choosing the station at the northern extremity, I was careful to select it as near the meridian of the southern one as possible, and likewise in the neighbourhood of some open spot of ground, proper for the measurement of a base of verification. A station having these advantages, was found near Clifton, a small village in the vicinity of Doncaster; and a level of sufficient extent for a base, on Misterton Carr, in the northern part of Lincolnshire.

In the composition of this account, I wish to confine myself to that part of my operations which relates merely to the matter expressed under its title. I am possessed of materials sufficient for another Paper; and shall give about thirteen hundred triangles, principal and secondary, when next I present an account of the Survey to the Society: professing this, I shall now say, that in 1800 and 1801, the angles of the triangles constituting the meridional series were observed; and that, in the latter year, the new base was measured on the abovementioned

Carr. I should not omit mentioning in this article, that while the instrument was at Clifton, the direction of the meridian was obtained from numerous observations on the pole star, at the times of its greatest eastern and western elongations from the meridian. It will be recollected, that similar observations were made at the station on Dunnose, in 1793; (see Phil. Trans. for 1795, page 460;) so that nothing relating to the terrestrial part of the operation remained to be performed at the expiration of 1801.

On my arrival in town, after the measurement of the base of verification in the north, I had the happiness of finding the zenith sector nearly completed. Little remained to be done, besides the dividing of its arch; an operation which Mr. BERGE proposed to defer till the following spring: it was then divided, and the instrument, being otherwise complete, was delivered into my hands in April. An observatory of convenient form having been previously made, the sector was immediately erected in the Tower; and, from thence, with the permission of Dr. MASKELYNE, it was sent to the Royal Observatory at Greenwich.

It is now necessary I should enter into a minute detail of this instrument's construction, giving a description of its several parts, with references to proper drawings. If, indeed, I had no other motives, I should perhaps be induced to do it from justice to the merit and memory of the ingenious inventor; who seems to have exerted his talents to the full extent of the hopes he entertained, of rendering this instrument the first of its kind.

General Description of the Zenith Sector.

In the sector I am going to describe, Mr. RAMSDEN has obviated the inconveniences attendant on the use of former sectors;

and has also diminished, in a very considerable degree, the errors unavoidably resulting from their imperfect construction. The principles on which he has founded the several improvements, consist in the means of uniting the sectorial tube to its axis, so as to ensure the permanency of the length of its radius, when erected for observation; more accurate methods of adjusting the instrument vertically; and an easy way of placing the face of its arch in the plane of the meridian. Another circumstance of moment was, some contrivance by which the plumb-line should be brought precisely over the point, marking the centre of the circle of which the divided arch of the sector should be a part. The last desideratum, the ingenious artist procured, by applying the same contrivance which so eminently displayed his skill, in the construction of the quadrant belonging to his Grace the Duke of MARLBOROUGH; a contrivance by which the plumb-line can be as readily adjusted over the required point, by a person standing on the ground, as any adjustment, or other act within his reach, can be performed. A description of this, as well as of the means by which the instrument is rendered vertical, and otherwise correctly prepared for observation, will be given, with the assistance of plates.

Plate IX. Exhibits a general view of the sector erected for observation: it consists of two parts; 1st, the frame which supports the apparatus to which the sectorial tube is attached; 2d, the work constituting that apparatus, with the tube itself.

The external frame or stand is made of mahogany, and unites strength with simplicity of construction. In shape, it is an obtruncated pyramid, whose base is a square of six feet in length, and whose vertex is half of it. This frame, although light in its make, is yet, when united by means of square-headed screws,

sufficiently firm. Inside this hollow stand is erected another frame, of the same substance, strong and well made, within which is suspended the sector; its frame being supported at top in every lateral direction, and sustained at bottom by a cone resting in a metallic concavity, the figure of which may be imagined, by supposing an arch of a circle to revolve round a tangent to one of its extremities. A cylinder, in the upper part of the interior stand, finds its place in an opening of an octagonal shape in the exterior frame, and, by a simple contrivance, is retained in that situation, while the sector and apparatus revolves on the cone. Thus, a ready means presents itself of turning the instrument round, with the face of its divided arch towards the east or west. It may be steadily retained in any position, by clamping it to the brass work of an azimuth circle, attached to the bottom of the external frame.

The direction of the meridian, at the place of observation, having been previously obtained from double azimuths of the pole star, this instrument admits of being placed in that direction very accurately. A telescope, twenty-nine inches in length, is attached to the side of the great tube, or rather, may be occasionally placed on a frame permanently fastened to it, having its axis in the plane of the divided arch, and very nearly at right angles to its radius. On the divided azimuth circle below, the angular bearing of any proper object may be set off, by turning the sector round till that object bisects the cross wires in the little telescope, and then noting the vernier. If the axis of the sector be horizontal, and the interior frame set perfectly upright, the instrument may be turned round from one point of the compass to the other, and properly adjusted for observation, in a few minutes.

In this general description, I am now to speak of one of the most ingenious contrivances attending the sector, which is, the means of readily adjusting the plumb-line in its several positions. I refer to the Plates and their descriptions, for a full account of it; but, as it will enable the reader to understand that which represents the instrument in its perspective view, (Plate IX.) I shall shortly describe this part.

The telescope of the sector is nearly eight feet long, and has an object-glass of four inches in diameter. It is attached to an axis, similar in shape to that of a transit-instrument, having at one end a lens, and near to the tube an arrangement of brass work, carrying a thin and diaphanous slice of mother-of-pearl, having, as appears to the naked eye, a dot upon it. The centre of this dot is by construction the true centre of the conical axis, and consequently of the circle of which the divided limb is a part. It is unnecessary to say, in this place, how that diaphragm was so adjusted as to have the centre of its dot where it should be, or the means by which it has been permanently fixed; it suffices that I say the point was placed most accurately, and the diaphragm fastened so firmly in the cone, that no readjustment of this part has been found necessary, since the sector came into my hands.

As the axis is hollow, a light, as that of a candle, held at its open end, is transmitted through the mother-of-pearl, which, stopping a part of its rays, exhibits a circle of red light to an eye looking through the lens at the opposite end of the axis; a well defined and exceedingly small dot appearing in the middle of the illuminated circle. Through proper openings in the upper and under parts of the axis, and suspended from a point not connected with it, passes the plumb-line, having its

position by construction *close to the dot;* so that, by looking through the axis in this way, the plumb-line appears like a small black line on the face of the mother-of-pearl.

Now it is evident that, to an eye thus placed, when the instrument is adjusted for observation, the plumb-line should appear as if accurately bisecting the dot. To give, therefore, the observer the means of moving it to the right or left, when standing on the ground, (avoiding thereby the inconvenient necessity of elevating himself on steps as high as the axis,) Mr. RAMSDEN placed a microscope, about 5 feet in length, parallel to the telescope, on the outside of the interior mahogany frame. This microscope, bent as it were at right angles at both ends, has one of them open, and placed close to the pivot of the axis carrying the small lens. In the upper part of the microscope, and just under its roof, is placed a speculum, inclined, at an angle of 45°, to the line passing through the centre of the sector's axis, and close to its end. This reflector receives the converged images of the dot and wire on the illuminated spectrum, and transmits them down the tube of the long microscope: the rays, falling on a *plano-convex* glass, at no great distance from the bottom, are finally sent out to the eye by a prismatic glass at the end of the tube. Thus viewed, that which to the naked eye above appeared a small dot on the illuminated lamina, when magnified, as delivered below, is seen to be a small and well defined circle with a luminous area, admitting of the most accurate means of deciding on the right position of the plumb-line, by exhibiting small portions of light between it and the periphery of the little circle.

The mode of illuminating the hollow axis is likewise ingenious. On the side of the interior mahogany frame, and opposite

to the vertical microscope, is suspended a lamp on two arches. At the back of it is a hollow cylindrical recess, in which is placed a polished metallic segment of a sphere. This concave reflector is attached to the cylinder, by means which give it any position required; so that the image of the burning wick, in the hollow of the lamp, may be thrown at pleasure on any spot above.

From the end of the conical axis, on the same side with this lamp, projects a small brass arm, carrying at its extremity a speculum, whose surface is placed at 45° with the vertical, and directly opposite the open end of the sector's axis. When the image of the burning wick is thrown from the concave reflector on the flat one above, the light passes through the hollow axis, illuminating the mother-of-pearl, and is, at last, sent down the microscopic tube to the eye below. This contrivance, collectively taken, is *unique*, and is full as accurate in its operation as ingenious in itself. From its nature, granting perfection of work, there can be no parallax between the dot and the wire. The images of the illuminated circle and wire, (plumb-line,) are coincident on the upper surface of the prismatic eye-glass, and transmitted so. In short, the whole has been so well managed, that the plumb-line can be made to bisect the dot or little circle, as accurately as the points on the divided limb of the sector. I consider this general description of this part of the instrument sufficient for the present; the proper plate, and its appropriate explanation, will supply what yet remains to be said.

The plumb-line is suspended above the upper part of the axis, from a point connected with the extremity of a bent lever, moveable round its fulcrum. The other end of the lever is acted on by a helical spring, which presses downwards, and causes

it to bear against a screw passing through a head of metal beneath that end. The extremity of the long screw is square, and has its place in a pipe attached to a mahogany rod, divided in the middle by a universal joint. One extremity of this rod is brought down, and received in a socket within convenient reach of the observer, who, looking at the image of the dot and wire, turns the rod, thus connected with the bent lever, and thereby gives motion to the plumb-line.

The pivots of the sector's axis are of bell metal, ground perfectly true and smooth. They rest in Ys, firmly attached to the upper part of the frame. The method of uniting the plates carrying those Ys, is as follows: at the upper part of the mahogany frame are four hollow strong cylinders of brass, which pass through the wooden work, and, at the same time, serve to connect very firmly the two sides of the upper part of the frame. These cylinders project about six inches beyond the surface of the wood, and have screws and nuts at their ends.

The brass plates furnished with the Ys, have four holes in each of them, which answer to the ends of the screws, and are attached to the cylinders furnished with those screws, by the respective nuts. In the Ys, the pivots of the axis are placed; and, as a means of adjusting each Y is fixed to each plate, any position, within a certain limit, may be assigned to the sector and its axis.

To prevent the pivots of the axis from moving to and fro in a sidelong direction, Mr. RAMSDEN adopted a contrivance for keeping them, at all times, in the same constant position in the Ys. This *desideratum* was not to be dispensed with; for, if the ends of the axis, from the thickening of the oil, or the accumulation of dust, should work laterally in their angles, the distance

between the plumb-line and arch would be continually varying; a perplexing evil, and the cause of great inaccuracy. The sum of this contrivance consists, first, in one of the Y plates having a small piece of brass screwed flat upon it, with a roller or friction-wheel at its end, which reaches just high enough to meet the vertical surface of the pivot a small distance within its circumference; and, secondly, in the other Y plate having a small apparatus, consisting of a lever furnished with another friction wheel and a spring, at its other extremity. This last mentioned roller, from the spring's action, presses against its proper pivot, and thrusts the other against the fixed wheel. By these simple but ingenious means, the axis is always retained in its proper situation with respect to the Ys.

To prevent the axis from bending, by the preponderance of the telescope and arches, Mr. RAMSDEN added braces and counterpoising weights. The braces are four in number, each being a hollow tube: they are fastened both to the axis and the telescope. Their principal uses consist in obviating the possibility of the telescope bending from accidental pressure, or vibrating when lightly touched. The method of preventing the telescope from sinking, or, in other words, the axis from bending, is by the use of levers and the abovementioned weights. These levers, two in number, are attached to the interior mahogany frame at top, the fulcrum of each being immoveable. At the end of each lever farthest from the tube, a weight is suspended, from a hook capable of being placed nearer to, or farther from, the fulcrum, at pleasure; thereby affording the means of raising the other end of the lever up against the cone, with any required degree of force. That extremity of the lever, so pressing upwards, has two large friction-wheels, which apply

themselves to the sides of the conical axis, but do not retard the free motion of it, when the telescope is moved in the direction of the plane of its arch. These wheels, two on each lever, support the axis near the junction of the telescopic tube; and, as a few ounces only are by these means suffered to press on the pivots, no bending takes place in the cones.

From the middle of the two uppermost horizontal cylinders, which unite the sides of the interior frame at top, and which receive, with the two beneath them, the respective Y plates, arises a small but substantial apparatus of metal, embracing a hollow brass cylinder, of five inches in diameter, and about three deep, which passes up into an opening in the upper part of the external mahogany frame. This cylinder, with its corresponding stand, are sustained, without any sort of shake, by a helical spring. This mode, with that of supporting the azimuth circle below, are so well managed, that when the instrument is properly adjusted for observation, the axis of the sector continues perfectly horizontal, in every position of the frame.

There is likewise a very convenient method of sustaining the sectorial tube in any required position for observation. Across the interior frame, about the height of the graduated arch, run two long brass axles, with two wheels on each, one precisely in the middle of the axle, (and consequently in the same plane with the line vertically cutting the middle of the telescope,) and the other close to the pinion at the end of the axle. From a steel pin, something peculiar in its construction, situated near the end of the telescope, proceeds a string, which is wound eight or ten turns round the pulley. Attached to the inside of the interior frame, and just above the wheels nearest to the end of the axle, is another pulley, over which, passing into a long and

narrow wooden compartment, is thrown a string, having a hook and a proper apparatus for receiving the moveable weights. The other end of this string is fastened to the pulley close to the axle, and gives motion to the telescope, or retains it in equilibrio, according to the arrangement of the two sets of weights, which consist of fifteen pieces of brass. By these means, all injurious pressure is taken off the point of the micrometer-screw, against which the telescope may be made to bear, with any required degree of force.

To cause the string passing over the middle of the pulley to draw in the exact direction of the limb's plane, Mr. RAMSDEN placed four small friction-wheels close to the eye end of the telescope, two on each side, and between each pair of wheels a steel pin, made like a T, with a hook at the end, to receive a string. This pin, where it applies to the wheels, is something in shape like a double cone, and is passed behind them. It always, from its construction, assumes the same position with regard to the friction-wheels; from which circumstance, the sustaining string is ever found in the plane passing through the centre of the telescope and the middle of the pulley.

The micrometer-screw, for measuring minutes and seconds, performs its operations in the usual way: it is moved backwards or forwards on a brass arch, parallel to the limb of the sector, and placed against the mahogany frame behind. To this arch the apparatus carrying the micrometer-screw is clamped; and it is adjusted, or brought parallel to the limb, by screws, so that the point of the micrometer-screw always bears exactly on the same part of the polished steel head, at the end of the sector.

The principal wires in the focus of the eye-glass are two, and are at right angles to each other. There are, indeed, two others

parallel to the meridional one, and at equal distances from it; they were placed there with a view of rendering an adjustment of the horizontal wire sufficiently easy. These are illuminated by means of the lamp which carries the concave reflector before spoken of. There is a hole, with a lens, in the side of the telescope, directly opposite to the lamp, having behind it a diaphragm of brass, coated with plaister of Paris, and inclined to the vertical axis of the tube, at an angle of 45 degrees. The quantity of light, suited to the circumstances of the observation, is regulated by coloured glasses, placed over the hole in the side of the tube.

The plummet, suspended at the wire, falls into a cylindrical cup, swinging by two pins on its edge, on the extremity of a brass frame annexed to the interior stand; which frame is capable of being raised or lowered at pleasure by a milled-headed screw; so that the wire can, at any time, be released from the weight of the plummet, by screwing up the vessel containing it.

There are two arches attached to the end of the tube, one on each side of it, and firmly united together by means of brass pillars; which arrangement effectually secures the divided arch from injury. The total extent of the arch is about 15°, having half of its subtense on each side zero. It is divided into every 5 minutes; the micrometer-screw measuring any supplementary quantity. Golden pins were let into the arch, by the advice of the Astronomer Royal, on which the divisions were laid off by Mr. Berge, in a very masterly and accurate manner, as will be seen hereafter. A magnifier, whose focal distance is about half an inch, is placed under the bottom of the cross piece opposite to the arch, and is furnished with a horizontal adjustment for bringing it directly over the plumb-line.

Among the various eye-pieces, of different magnifying powers, is one furnished with a prism. This, necessarily bent at right angles, enables the observer to see the stars without touching the frame. The use of it has been found convenient; but habit and proper caution enable the astronomer to use either of the other glasses. Having given this cursory and general description of the instrument, as seen at first view, I shall proceed to an explanation of the plates, which show its various parts.

Particular Description of the Zenith Sector.

Plate X. Represents a general section of the instrument and stand. AB is one of the four great uprights of the external mahogany frame, and CB its top, having an opening in D, for admission of light. The uprights consist of two strong pieces, firmly screwed together; each upright having seven strong screws, as seen in the upright AB. The top may be considered as a sort of square table, screwed down on the upper part of the frame. Between each of the two uprights is a brace, diagonally fixed, for strengthening the stand, as may be seen in the plate; and four others go horizontally, from upright to upright, for the purpose of still farther strengthening the whole. Across the bottom of the frame, and exactly in the middle of it, is a very strong mahogany plank, whereon rests the sector, having a stout straight edge bar of the same substance underneath. In the middle of this cross piece, as seen at E, is an apparatus of brass, furnished with an azimuth circle, having a hollow receptacle of bell-metal in the centre, in which rests, on a conical point, the interior mahogany frame FGHI. This brass work, which is strong and substantial, may be seen in Plate XIV. It is there represented *in plano*, with the bottom part of the interior stand

placed above it. The means of making the interior stand vertical, are found in the work annexed to the azimuth circle. They consist of two screws, attached to two plates of brass, placed at right angles to, and also flat on each other. S *s* (Plate XIV.) are the screws. A vernier on the divided circle may be seen at S; and at *s*, the method of clamping the bottom of the stand. On the opposite side is another provision for clamping this stand, when the face of the sector is changed from east to west, or *vice versâ*.

KLMNO*p* (Plate X.) is a section of the telescope and axis, MR, MR, being two of the four braces for strengthening the axis, and steadying the telescope. K is the place of the eye-tube; L the elliptical reflector for illuminating the wires at K; and ON a hollow cylinder of brass, independent of the tube. In the upper part of this cylinder, the object-glass is rivetted; the cylinder itself being fastened to the great eye-tube, in a permanent manner.

W, W, are two weights, hanging freely from the ends of two levers, the opposite ends being furnished with four friction-wheels. The points of support, between the weights and wheels, are at TT, being at the extremities of two upright solid pieces of metal, which are moved up or down by the screws beneath them. These counterpoising weights prevent any bending of the axis, between the pivots and those parts to which they apply. The apparatus for carrying the levers, is attached to the inside mahogany frame by screws, as represented in the section. See also Plate XIII.

The plummet and plumb-line are seen at *aed;* the point of suspension being *a*, and the plummet *d;* the plumb-line passing close by the arch, whose section is *bc*, and also near to the dot

or small circle *e*, described on the thin slice of mother-of-pearl, shown in the section of the axis at *e*.

A lamp is attached, or rather rests, on circular supports annexed to the side of the interior frame, and may be seen at XZ. At the back of the lamp, placed in a recess, is a concave reflector at Z; and, in the front of it, a tube running out to X, having a double convex glass at P, for throwing the light on L, which first passes through a double concave glass in the side of the telescope, and then, from the reflector L, is thrown down on the wires near K. The concave speculum Z, has two adjustments for converging the reflected light on the little elliptical speculum *b*. This last-mentioned speculum throws off the said light at *h*, which passes into the axis at G, illuminating the mother-of-pearl at *e*, and, finally, is transmitted out of the axis at *p*.

klmn, is a section of the long microscope, for conveying the image of the dot and wire, sent out of the axis at *p*, to the eye at *k*. This microscope is firmly attached to the side of the frame, by brass cylinders, *kk*, *ll*, *mm*, *n*, and has one plano-convex glass at *q*, a prismatic eye-glass at *u*, and a metallic reflector at the top, *o*. At the upper end of this long microscope, and directly behind the speculum, is a screw, by which the reflecting metal is brought into one of its requisite positions. The other adjustment of that metal is performed by two screws, which apply to the sides, and give it lateral motion. The plano-convex glass at *q*, is rivetted into the head of a long tube *uq*, which slides up the microscope. The upper part of the microscope at *o*, is placed exactly opposite the end of the axis, in a very firm way.

The rod for giving motion to the plumb-line, is *vwx*; *v* being the top of it, *w* the place of the universal joint, which separates the two parts of the rod, and *x* the bottom of the rod

itself, to which part the hand is applied. In this section, the top *v* is not furnished with the pipe connecting it with the bent lever above; but the representation of it, together with the lever itself, and accompanying spring, will be understood by referring to the plate which contains a representation of those parts.

In Plate XII. is a section of the axis passing through the pivots, and one exhibiting the face of the several united planes constituting the diaphragm, which adjust, in every direction, the slice of mother-of-pearl. Above this latter, is a view of the lever which gives motion to the plumb-line, with the pipe, spring, &c.; these are represented as seen from an eye at one of the pivots; and, above the other section, is a view of the same apparatus, seen in a direction at right angles to the former one.

In the latter of the above-mentioned sections, *hab* is the diaphragm, having in the middle, as at *p*, a circular piece of mother-of-pearl, extremely thin, with a small dot in the centre. This brass work is annexed to the large end of a hollow conical piece of brass, which exactly fits the axis at its proper place. It is there screwed fast, and may be considered as of one piece with the axis. In the adjoining figure, *hfkl*, is a section of the cone, *p* being the place in the opening of the brass work which receives the mother-of-pearl. In the representation of the diaphragm, *a* and *b* are two screws, at right angles to each other, and respectively attached to flat pieces of metal which slide on each other. If *fh* represent the plumb-line, the direction of each screw is that of an angle of 45 degrees with it. By means of these adjusting screws, the dot or little circle at *p* was placed in its proper position, or in the centre of the circle *abb;* so that, on an adjustment of the plumb-line, in any one position of the instrument, the dot still remains accurately bisected, however

the telescope be subsequently moved. Above *abb*, is a small frame-work of brass, from which the plumb-line depends: it is attached to two of the four horizontal tubes on which the Y frames are fastened. *cd* is the pipe fastened to the end of the rod; the end of this pipe has a screw, which passes through a nut, and acts against the end of the lever *d*, whose centre of motion is *g*, and whose other extremity is *f*, where there is a small piece of hard steel with a notch, for the reception of the plumb-line *fh*, suspended from *g*. Against the upper surface of the arm *gd*, a helical spring continually presses downwards; it is fastened above the end of the lever, at *e*; by which means, the arm *gd* is constantly pressed against the end of the pipe, obviating the possibility of any play or shake of the lever, round its centre *g*.

The same figure contains an elevation of the frame-work just described, as seen by an eye in the plane of the diaphragm produced. It is necessary that it should be closely inspected, for the purpose of obtaining an adequate idea of its construction. In this figure, *xv* is a small cylinder, with a screw and loose collar at the end *v*, for fastening the plumb-line, which goes over the notch *n*, and passes through a hole in the upper part of the axis at *f*, and out again at *h*, almost touching the mother-of-pearl at *p*. *sru* is a strong spring, fixed at *s*, through the middle of which, at *r*, passes a screw, which is, in fact, an adjusting screw, for bringing the plumb-line close to the dot on the surface of the diaphragm; and here it is necessary to observe, that the plane of the divided arch and that of this diaphragm, are one and the same when produced. There is no part of the instrument more complete than the apparatus for suspending the plumb-line, and that which regards the dot. I

shall now return to a farther consideration of the construction of the axis.

In Plate XII. there is also a horizontal view of the upper part of the axis; A being the head of the microscope, and B the little diagonal speculum, for throwing the light on the diaphragm. C is the opening in the axis above the object-glass; and D a brass slider, for covering the opening at C. E and F are two pulleys, attached to the side of the axis, over which pass two strings, having their ends united in opposite points of the shutter D; the other two ends of the string being within reach of the observer, who by this means easily opens or shuts the slider.

In Plate XIV. ABCD is the moveable frame, fastened to the top of the external stand, and having an octagonal opening at E, for receiving the brass work connected with the four horizontal pipes carrying the Ys. The touching points between the octagon and cylinder, are *g*, *h*, *n*, at which parts of the frame hard pieces of metal are inserted. To prevent all possibility of shake in the cylinder, which would render an adjustment of the instrument troublesome, if not impossible, there are two strong screws at *m* and *n*. One is a helix, which acts against *m*, and against the end of the sliding piece *n*; so that, by a condensation of the helix by the screw *m*, the piece *n* acts against the head of the cylinder inserted in E.

Plate XI. represents an elevation of the instrument seen sideways, and is that part to which the long microscope is attached: it serves to show the formation of the interior stand carrying the sectorial tube. A B C D E F are mahogany uprights, firmly united at the bottom and sides by proper cross pieces, and at top by the plate of metal *a b c d*, through the ends of which pass those of four horizontal pipes, the plate *a b c d* being one which

carries a Y, hidden in this elevation, by the upper part of the head of the microscope.

In the middle of the cross pieces, which unite the side of the frame to its corresponding one, are two wheels with long axles, as before mentioned. In this elevation they are seen at B and E; and have strings passing from them to their respective sides of the tube, where they attach to the pins P, P. At the ends of the axles nearest to this elevated side are two other pulleys. In the view which this plate affords, these wheels are projected against the others just spoken of; but their uses will be more readily understood, on perceiving the strings which pass over the upper pulleys, and afterwards sustain the weights W, W, in their upright cases.

In this elevation is seen the telescope attached to the side of the great tube: it is used when the instrument is got into the plane of the meridian. The vessel for receiving the plummet is seen at V; and at S the adjusting-screw, for elevating or depressing the frame which supports it. LL is the clamp-arch, supposed to be attached to the other side of the tube, or that which supports the lamp. At the bottom of the stand is seen the azimuth circle, and the apparatus belonging to it.

For the purpose of conveying a clear idea of the arrangement of the lower pulleys, and the manner in which the two arches are joined to each other at the end of the telescope, there is given, in Plate XII. a horizontal view of the same. The vessel for receiving the plummet, its supporting frame, and the magnifier for viewing the dots or points on the divided limb, are likewise represented. The body of the telescope is here taken away, leaving nothing more than the plate at its end, with the contiguous work belonging to the wires.

To show with distinctness and sufficient perspicuity, the manner in which the cross wires are sustained in the tube, also the means by which they are adjusted, figures are given in Plate XII. These also show the micrometer-screw, and the mode of clamping it to the proper arch. In the horizontal representation of the end of the telescope, the wires are seen in the centre, and also the two screws, with the helical spring for adjusting and retaining them. EF is a strong brass arch, with an edge bar IK, placed parallel to the divided arch. At EF are seen two milled-headed screws, passing through a metallic embracement of the bar and arch, which are firmly connected with the apparatus belonging to the micrometer by their means. At S is a piece of hard polished steel, against which the point of the micrometer-screw rests; and, as the arch EF is the segment of a circle whose radius is its distance from the axis of the sector, the point of that screw always buts against the steel head in the same place. In this plate is also seen a vertical section of the same parts. Here, EF is the back arch, and MS the micrometer-screw. This figure also shows the means by which the pieces carrying the wires, and inserted into the end of the telescope, are retained in their proper places. CA and DB are two long pillars, which pass through an annular piece of brass parallel to the end of the tube.

A screw with a windlas-like head is seen at G, from the turning of which, the wires are moved in one of their proper directions. A screw for giving them a motion at right angles to that obtained by the fore-mentioned one at G, is seen in the horizontal view of the end of the telescope at H.

It would be swelling this account to an inconvenient size, if I were to attempt any farther explanation of the plates; I shall,

therefore, close this article with a few observations on the manner of adjusting the instrument for observation.

Manner of adjusting the Instrument for Observation.

The feet of the external stand should be first carefully brought into a horizontal plane; and, when they are so, the azimuth circle will be, necessarily, parallel to it, having its centre under the middle of the opening in the mahogany frame screwed on the top of the stand. This being done, and the instrument set up, the plane of the arch should be brought parallel to one of the sides of the stand, in which situation, the internal frame is to be clamped to the azimuth circle, and the wire brought to its proper distance from the limb, by means of the adjusting-screw attached to one of the sliders, which carries the concave receptacle and conical point. The dot at zero should then be brought exactly under the plumb-line, as seen through the magnifier, and the point on the micrometer-head, at which its index stands, noted. The instrument is then to be turned half round; and, if the same dot on the arch still continues bisected, it will afford a proof of the internal stand being upright in one direction. But, if the dot should not continue bisected by the plumb-line, it must be made to do so, and the revolutions, or parts of a revolution, counted; half of which is to be turned back on the micrometer-head. The same dot, zero, is then to be brought under the wire, (plumb-line,) by means of the other adjusting-screw beneath the azimuth circle. If the stand is pretty accurately set up, one operation is sufficient for bringing the interior frame upright in one direction, *viz.* either in that of the meridian, or the one at right angles to it. The arch is then to be turned

round 90°, and the same operation gone through. This being properly done, the interior frame is made perfectly upright.

The next step to be taken, is that of placing the long level on its axis above, and rectifying that axis by means of the Y plate screws. If this be done carefully, the bubble will remain between the pointers of the level, whatever position the sector may be placed in. Having thus rectified the instrument, by making the internal frame upright, and the axis horizontal, the only remaining point to engage attention is, placing the plumb-line at a proper distance from the arch: this is done by means of the screw acting on the spring just under its point of suspension. If great care be used in going through these several adjustments, the instrument may, at any future time, be accurately adjusted for observation, by turning the proper screw belonging to the azimuth circle, and bringing the arch to its usual distance from the wire.

Laying off the Points, or dividing the Limb of the Sector.

The first step preparatory to finding the length of the radius, was to mount the sector in its frame, and adjust the counterpoising weights. By attention to the proper points on the levers, the axis was kept from bending, the pivots not having more than a weight of two pounds to support. This done, a tool with a well defined point was made to press lightly against the face of the arch, and firmly sustained in that situation, while the sectorial tube was slowly moved to the right and left: a fine line was by this means described on the limb, passing through the centres of the golden pins. The arch having been thus struck, the telescope was taken out of its frame, and laid on the

edge of a very strong plank, having its axis horizontal, and the pivots resting in Ys firmly fastened in the middle. The end of the arch, whose face became vertical, was supported by a brass plate screwed down on the end of the plank. When the pivots were placed in the Ys, and the telescope sustained in several places, to keep it from bending, a brass slider, on the surface of the plank, was moved till the line before mentioned coincided with that described on the arch. The telescope was then quickly taken out of the Ys, and, as speedily as possible, brought into a similar position on the other side; for which purpose, braces to support the tube had been previously prepared. By these means, twice the length of the radius was obtained; proper care having been taken to have the Ys so placed, that the centre of the pivots should be in the same plane with the two sliders at the extremities of the plank. The distance between the lines was then measured, and $\frac{1}{16}$ taken for the chord of 7° 10′, which was immediately laid off on the face of the sector, on both sides zero.

Although little doubt could be entertained of the truth of the total arc thus assumed, yet, that the length of its chord might be compared with that derived from the usual modes of operation, Mr. Berge (as proposed by Mr. Ramsden) prepared a brass arch, which he let into a frame, on which, after striking a portion of a circle with the radius obtained as above, he laid off the chord of 60°. This arch he divided by continual bisection, till he obtained the chord of 7° 10′, which he compared with the same angle laid off on the sector's limb. He had the satisfaction of finding no perceivable difference; and, that there really existed none, was denoted by the unresisted fall of the points into their respective holes. The arch of the sector was then divided

into degrees, and every degree into five minutes; and the holes were afterwards opened with a tool made for the purpose. As gold pins had been let into the arch, Mr. BERGE was enabled to go through the division of it with great success, and afterwards to enlarge the holes, without destroying his accurate work. The observations will offer a more satisfactory testimony of the credit due to his abilities as a workman, than any opinion which I might express myself as entertaining, although founded on the same *data*. It remains for me only to observe, that I think he has delivered this instrument into my hands without any imperfection of execution; and that I believe it would not have been superior, had the ingenious inventor lived to complete it.

Adjustment of the meridional and horizontal Wires.

After the arch was divided, the axis of the telescope was laid on a pair of Ys connected to a firm support, and made nearly horizontal. The tube was then brought up to a level with the axis, and sustained at proper intervals, whilst the end of the telescope rested on a small piece of metal connected to a fixed bar, by means of an adjusting-screw. This end was then moved, till an object sufficiently small, (a speck or dot,) at a proper distance, appeared nearly in the centre of the field. The telescope was then properly secured from bending, and rendered perfectly steady, but admitting of a small motion sideways, the Ys having also a corresponding adjustment.

A microscope, furnished with a moveable wire, was then fastened to a beam attached to the brick wall, and its end brought close to the edge of the arch of the telescope. Upon this edge, as well as on that of the other arch, Mr. BERGE had the address to lay off a point, very nearly in that place where the

plane passing through the axis and zero cuts the arches. This being done, the telescope and Ys were moved laterally, till the vertical wire bisected the speck. The system of wires was then turned, till the meridional one was made exactly perpendicular to the axis, as seen from the mark being bisected in every part of the wire, when the end of the telescope was moved up and down by the adjusting-screw. The axis was then carefully taken out of the Ys, and inverted: it was afterwards placed as before, and the distance between the spot and vertical wire estimated by the eye. The telescope was then moved in azimuth, half that quantity, and the meridional wire brought to a bisection on the speck. Repeating this operation twice or thrice, the vertical wire became accurately perpendicular to the line passing through the centre of the conical axis, and also in the plane passing through the centre of the tube.

The next step was, to move the whole system of wires in the direction of the perpendicular, in order that the horizontal one (at right angles to the vertical wire by construction) should be also brought into its proper position. For this purpose, the telescope was moved a little in azimuth, and the proper wire made to bisect it accurately, at which time, the wire of the micrometer before mentioned was brought over the dot on the edge of the limb.

In this position of things, the instrument was taken off the Ys, and turned over; it was then again carefully placed in its former position, and the end of the telescope brought up by the adjusting-screw, till the distant speck was bisected by the horizontal wire. Now, if this horizontal wire had been, by accident, placed so that the point of intersection of the two wires was

exactly in the true centre of the telescope, the dot on the edge of the other limb would have been bisected by the wire of the anterior microscope. This was found not to be the case; but it was made to be so, by halving the differences, and moving the horizontal wire so as to bisect the mark. After this had been again examined, the vertical wire was examined, when it was found necessary to go through a part of the operation a second time. This was to be expected; but the wires were, by these means, at last properly placed, and guards were then fixed over their adjusting-screws. I shall now proceed to speak of the use I made of this sector in the year 1802.

Particulars relating to the Operations of the Year 1802.

I have already stated, that a proper observatory had been provided for the reception of the zenith sector. The dimensions of it were twelve feet square at bottom, and six feet square at top; its proportions being the same as those of the external stand. A floor having a square vacuity, to admit of the instrument standing on the ground, covered the joists of it. The sides of the observatory were of strong painted canvas; and the roof of wood, with an aperture, which could be opened or closed at pleasure, for viewing the stars near the zenith.

The instrument, with this observatory, was erected in the Tower on the 3d of April, merely to examine all its parts, and to ascertain whether any thing could be done to render it more perfect. Some trifling *addenda* were accordingly made, and the whole, thus rendered perfect, was removed to the Royal Observatory, and erected in the garden of the Astronomer Royal, close to the eastern extremity of the transit room.

I am now to specify, that my intentions were to devote, from this period, the whole or the greatest part of the following summer, to the use of this sector; nor did I indeed imagine such a portion of time more than sufficient. I purposed to erect it at Dunnose, and at Clifton, the extremities of my arc; and also at Arbury Hill, near Daventry, the station almost in the middle of it. This last station I fixed upon, because it was proper to ascertain how far the observations for determining the extent of the whole arc, would agree with any others made for finding the value of its parts. The erecting of it at Greenwich was necessary, for the purpose of observing the zenith distances of certain stars, which were afterwards to be observed at Dunnose, thereby affording means of ascertaining the latitude of that station.

The instrument remained at the Royal Observatory till the 26th of April; and, although the weather was for most part of the time unfavourable, yet the erecting of it there will be found, as appears in a future part of this work, to have answered the proposed end. One very material service accrued to myself; this was, the advice and instruction I received from the Astronomer Royal, for the successful management of the sector, by which I scrupulously governed myself throughout the whole of the subsequent campaign. Having observed the zenith distances of some few stars, and made myself completely master of every adjustment about the instrument, the sector, with all its apparatus, was sent to the Isle of Wight, by way of Southampton; every possible care being used to protect it from injury, not only while transporting by land, but also when under the act of being taken into, and removed out of, the vessel which conveyed

it from that place to Cowes. It will be readily supposed, that watchfulness and care were necessary, to preserve this complicated instrument from being damaged by accident or roughness of the roads.

In the year 1794, an iron cannon was sunk in the ground, for the purpose of permanently preserving the point on Dunnose, where the direction of the meridian was observed in 1793. It must be now remarked, that the cannon so inserted could not have its breech placed so low as might have been wished; in consequence of which, it became necessary to erect the observatory for the reception of the sector some little distance southward of the old station. The distance from the centre of the gun to the point over which the instrument was afterwards erected, was six feet and a half.

To procure for the external stand, and thence for the whole apparatus, a firm foundation, I caused four long stakes to be driven into the ground, one for each foot of the stand, to which its feet were firmly screwed down. The surfaces of the stakes were then cut off smooth, and brought into the same horizontal plane, by which means, the interior frame and sector were placed much within the limits of their several adjustments.

The pointed top of Sir Richard Worsley's obelisk afforded me an excellent means for bringing, with the assistance of the side telescope and azimuth circle, the plane of the arch into the true meridian. The distance and magnitude of that object is extremely convenient for the purpose. Its bearing from the meridian of the station is $87^\circ\ 42'\ 33''$, as I shall show in its proper place. The side telescope was turned to this object very frequently; and I never found the vernier, on the azimuth circle,

to indicate any serious warp in the stand. Its greatest variation was 4′; but, for several days together, it did not amount to 30″.

The weight of the plummet, I adjusted to the strength of the plumb-line, in the usual way. I suspended it in air, and gradually increased its weight, till the wire broke. This plummet was then immersed in the vessel appropriated for its reception. It will, perhaps, not be improper to observe, that I was careful to give the plummet its maximum of weight, that its wire might not be subject to motion from streams of air.

As it was to be apprehended that errors would result, from the effects of an inequality of temperature in the air within the observatory, I placed two thermometers, both adjusted to a third, near the telescope. One I elevated as high as the axis, the other I laid on the hollow brass cylinders which connect the divided arch with that behind it, usually called the back arch. In the day, I found (as may be seen in the register of observations) the heat a little greater at the top of the tent than towards the bottom; and the reverse was generally the case at night.

To equalize the temperature at those times when the sun shone out, or the weather was hot, I opened the shutters in the roof, as well as the door of the observatory, a considerable time before the moment of observation. By these means, the air within the tent was rendered tolerably uniform in its degrees of heat. For the space of a week following the commencement of my observations, I suspended a third thermometer from the milled-headed key which turns the diaphragm placed inside the telescope. As the situation of this thermometer was midway between the two others just mentioned, I always found the temperature there, a mean between those degrees shown by the

upper and under thermometers; and as, in the course of the time specified, I had various opportunities of satisfying myself on this point, I desisted from making any farther use of it. For the purpose of ascertaining the limits of the errors likely to result from the cause now spoken of, it will be right to institute some little inquiry into its mode of operation.

In Plate XVI. Fig. 1, let CD be the line passing through the centre of the sectorial tube, brought into any position for observation; the angle made with the zenith being ACB, and CA the consequent direction of the plumb-line. CB and BA may therefore represent the radius and arch of the sector, when in a state of uniform temperature throughout.

Now, at any time, let the thermometer at the top C, indicate a degree of heat superior to that shewn by the other at B; and let it also be supposed, that the difference between those degrees of heat, at any intermediate point, is directly as the distance of that point from C or B; and farther, let the tube CB be extended to D, while the arch AB continues of the same length.

If the line CA be extended to F, and the line AE be drawn parallel to BD, meeting the arch FD in E, then will the small space FE measure the error in the observed zenith distance of the star.

As the angle ACB must in all cases be small, ACB and EF may be considered as two similar sectors of circles; under which supposition, we get $FE = \frac{AB \cdot EA}{CB}$; and, applying this to an extreme case occurring at Arbury Hill, on the 12th of September, we get $AE = \frac{5^{\circ} \times 0{,}0001237 \text{ inches} \times CB}{2 \times 12}$, hence $FE = \frac{5^{\circ}. \times 0{,}0001237 \times 6^{\circ}.26'}{2 \times 12}$ $= 0'',596$.

As few of the stars selected for observation were, at either of

the stations, so far from the zenith as 6°, it is obvious little inaccuracy can have resulted from the difference of temperature here spoken of; and this supposition will receive farther support, from the actually near approach of the two temperatures to an equality with each other, as appears by taking the mean results of the last two columns in the register of observations. That the scrupulous mind may be satisfied in this particular, I shall insert, in its proper place, a table for supplying the correction arising from this cause; as the effect of a greater heat in the upper part of the tent is an error in excess, so a reverse of the case produces one in defect.

On the first convenient opportunity, I measured, with great care, the distances between every successive set of dots on the divided arch, contained between zero and 7° 10′. This was done at a time when the thermometers denoted a perfect uniformity in the temperature of the air within the tent, and when, from the calmness of the day, no streams of air could affect the plumb-line. Although I had, previously to the performance of this matter, perfectly satisfied myself that the rays of heat, emitted from the lamp illuminating the face of the arch, do not expand it perceivably, yet I thought it best to wait for a day when the strength of the light should enable me to discover, and properly bisect, the points, without the aid of that lamp. Between zero and 7° 10′, on the left hand arch, I found there were 430 revolutions of the micrometer-screw + 38,2 divisions; and, between the same point and 7° 10′ on the right hand, 430 revolutions + 39,2 divisions.

From this it appears, that the mean value of one revolution of the screw, is 0′ 59″,098. Mr. Berge endeavoured to place the arch, carrying the apparatus of the micrometer, so that one revolution

of the screw should be exactly a minute. On trial, he found it nearly a second short; for which reason, he divided the head into 59 parts, and called each of them a second. I think it proper to repeat the observation, that the two arches were measured with the greatest care, because it admits of the remark, that every space subtending 5′ was measured with the *same part* of the screw, beginning very nearly from 9 on the index. This instrument will, at a future period, probably pass into other hands; it may therefore be right to state, that I found, from an examination of the screw, an error of nearly 1″, in the part contained between 17 and 19 on the index, arising from a small notch which, with a magnifier, I could plainly perceive on one of the threads. As it cannot but be the general wish to have some evidence of the accuracy with which this sector has been divided, and also how far I have succeeded in the performance of what is now under consideration, a table will be given, in which the value of every 5′, in the first degree on each side zero, will be found in revolutions and parts of the screw.

Having towards the end of June found my observations sufficiently numerous, and apparently sufficiently accurate, from the regular differences subsisting amongst them, I took down the sector, and, with every thing belonging to it, repaired to Clifton, the northern extremity of my arch. The instrument arrived there in safety, on the 20th of July; and, as the direction of the meridian had been previously determined, the instrument was immediately set up, and made ready for use.

At this station, Laughton spire afforded me an excellent mark for adjusting the instrument in the plane of the meridian. The bearing of it is 1° 56′ 12″ south-west; and, from my being able to see it in the observatory, without rolling up either of its

canvas sides, I had ready means, at all times, of turning the telescope to that object. And I can take upon me to say, that during the whole of my stay at this station, I never found the instrument out of the plane of the meridian more than half a minute.

Of the 27 stars observed at Dunnose, 17 were observed at this station; they were the following, *viz.* β, γ, 45*d*, 46*c*, 51, 16, μ, Draconis; 1κ, 10ν, Cygni; η, ξ, Ursæ; 22τ, 85ν, 52, v, Herculis; α Persei, and Capella.

As the weather for most part of the time proved favourable, the observations were completed on the 22d of July; and, as there appeared to be sufficient time, between that period and the arrival of the season which would necessarily terminate my operations, to carry on my meridional line to the Tees mouth, I reconnoitered the country in that quarter, and selected the stations all the way between it and Clifton.

On the 23d of July, the instrument and observatory were taken down, and the large theodolite erected over the point. White lights were sent to the distant stations, and were all observed, except those fired on the 30th day of the same month; and, as the night on which those lights were burnt was remarkably clear, and it was therefore probable that some intervening land obscured the distant hill, I desisted from making any farther attempt towards the execution of the above scheme, as any greater loss of time might prevent me from making the proposed observations on Arbury Hill. I therefore sent the sector to this last-mentioned place, where it arrived on the 3d of September, and was erected on the 7th, the direction of the meridian having been previously ascertained, by two double azimuths of the pole star. But it is proper I should observe,

that the sector was not set up over the old station, as injury to some amount would have been sustained by the person farming the soil, owing to its cultivated state. The spot on which I fixed, was 34 feet to the north, and 28 towards the west, of the former station.

Of the stars seen at Clifton, 12 were observed at Arbury Hill. These observations were continued, with very little interruption, till the 4th of October, when the party, with all the apparatus, returned to London; the zenith sector being found as perfect on its return as when first sent into the field, a circumstance inferring both the strength and perfect union of its parts.

Particulars relating to the Measurement of a new Base Line, on Misterton Carr, in the Year 1801.

The apparatus used for the measurement of this base, was the same as that employed on Hounslow Heath, Salisbury Plain, and Sedgemoor; and the like pains were taken to ensure its accuracy, as were used on those occasions. The points for lining out the base were put into the ground with great truth and precision; the large theodolite being used as one of the means, and in the same way as in measuring the base on Salisbury plain. Previous to the commencement of this operation, two large blocks of oak, with square holes on their upper surfaces, were sunk in the ground, at the extremities of the base; the point of intersection of the diagonals of each hole, severally denoting them. These diagonals were drawn on lead, cast into the holes, and ground to a smooth plane, even with the surface of the block.

Before the measurement began, the working chain A, and the

50-feet chain, were both compared with the standard B. For this purpose, a calm cloudy day was waited for, which opportunity presented itself on the 2d of June. The pickets for the registered heads were then driven into the ground a considerable depth, and the coffers laid in a right line between them. The chain A was then laid out perfectly straight; and five thermometers, equally distant from each other, were put close to its side, their temperatures being as follows.

Thermometers.

1	—	2	—	3	—	4	—	5.
67°		65°		67°,5	—	67°,5	—	67°,5.

The chain A was then taken out of the coffers, and B laid out in its stead. The difference of their lengths, which was measured with the micrometer-screw, was found to be 1 revolution 6 divisions, *viz.* A longer than B; the temperature remaining constant the whole time of trial. In the course of the day, the same operation was repeated, the five thermometers standing at 69°,5—69°—69°,5—69°—69°, when B was found to be 1 revolution $6\frac{1}{2}$ divisions of the micrometer-head shorter than A. Therefore, the mean, *viz.* 1 revolution $6\frac{1}{4}$ divisions, was considered as the true difference of their lengths. The length of twice the 50-feet chain was, at this trial, found to exceed that of B, 2 revolutions 4,5 divisions; which is nearly the same determination as formerly resulted, from a comparison of the chains with each other on Sedgemoor. It may be seen too, by referring to the account of the measurement of the base on that spot, that the difference between the lengths of the standard B and common chain A, was nearly the same at that period as now; the difference being 1 revolution 7 divisions. I therefore concluded I might,

with safety, suppose the length of the standard chain B to be exactly the same then, as at the period when Mr. RAMSDEN compared it with the points inserted into the cast iron bar, mentioned in the first account of the trigonometrical operations.

The measurement of this, the fourth base, commenced on the 6th of June; and was continued, without much interruption from bad weather or other causes, till the 28th of July, when it concluded with the 263d chain, the overplus, 38,321 feet, being carefully determined, by means of a silver wire and pointed plummet let fall over the point marking the north-west extremity of the base. The two chains were then carefully compared with each other; when it was found, that the wear of the chain A was exactly one division on the micrometer-head, or $\frac{1}{260}$ part of an inch. As the length of this base is nearly the same as that on Sedgemoor, it was reasonable to suppose that the elongation of the chain, by the working of the joints in each measurement, would be found the same, provided no injury had taken place from accidental circumstances, or rusting of the pivots and holes, during the time the chains were laid up in the Tower. After the reduction of the base, I shall have occasion to show that my ideas were correct in this point, as Mr. BERGE has lately remeasured both chains.

Angles of the great Triangles observed in the Years 1800, 1801.

At Beacon Hill.

Between	°	′	″	Mean.
The north and south end of base -	20	47	19	″
			20	19,75
			20,25	

Between	°	′	″	Mean.
North end of Base and Gringley -	34	44	40,75	
			42,25	42,25
			42,75	
			43,25	
Gringley and south end of Base -	13	57	22,75	
			24	24
			24,25	
			25	
Heathersedge and Gringley -	138	9	15,5	
			16	16
			17,5	
At North End of Base.				
Beacon Hill and south end of Base -	60	17	16	
			16,25	16,5
			17,25	
Beacon Hill and Gringley -	74	46	55,5	
			56,25	56,5
			57,25	
			58	
At South End of Base.				
Beacon Hill and north end of Base -	98	55	26	
			27	27,5
			28	
			29	
Beacon Hill and Gringley -	114	51	31,5	
			31,75	
			32,5	32,5
			32,75	
			33,75	
At Gringley.				
Beacon Hill and south end of base -	51	11	5,25	
			5,75	
			6,75	6,5
			7,25	
			7,5	

Between	°	′	″	Mean.
Beacon Hill and north end of Base -	70	28	21,5 21,75 22,5 23,25	″ 22,25
Beacon Hill and Heathersedge -	23	10	5 6 7	6
Sutton Ashfield and Heathersedge -	46	20	23,5 24,5	24

At Heathersedge.

Beacon Hill and Gringley - -	80	40	37,75 38,5 39,25	38,5
Sutton Ashfield and Gringley -	54	52	36,5 37,5 38,5	37,5
Orpit and Sutton Ashfield - -	39	8	37,25 37,75 38,25 39,5 39,75	38,75

At Sutton Ashfield.

Heathersedge and Gringley - -	78	47	1,25 2,25 2,5	2
Orpit and Heathersedge - -	60	22	24,5 25,5 26,5	25,5
Hollan Hill and Orpit - -	113	49	8 9 10	9

At Orpit.

Between	°	′	″	Mean.
Heathersedge and Sutton Ashfield -	80	28	56,25	″
			56,75	57,25
			57,75	
			58,25	
Hollan Hill and Sutton Ashfield -	21	27	19,5	
			20	
			20,5	20,5
			21	
			21,75	
Bardon Hill and Hollan Hill - -	62	8	24,5	
			25	25
			25,5	
Castle Ring and Bardon Hill -	56	3	13,75	
			14,75	14,75
			15,75	

At Hollan Hill.

Sutton Ashfield and Orpit - -	44	43	30,75	
			32,5	32
			32,75	
Bardon Hill and Orpit - -	74	52	36,25	
			37,75	
			38,75	38
			39,25	

At Bardon Hill.

Hollan Hill and Orpit - - -	42	58	58,75	
			59,25	
			59,75	59,5
			60,25	
Castle Ring and Orpit - -	68	24	3,75	
			4,75	4,75
			5,75	
Corley and Arbury Hill - -	38	25	12,5	
			13,25	13,25
			14,25	

At Castle Ring.

Between	°	′	″	Mean.
Bardon Hill and Orpit - - -	55	32	43	
			43,25	
			43,75	44
			44,25	
			44,75	
			45	
Corley and Bardon Hill - -	47	54	40,5	
			41,75	
			42,5	42,25
			43,25	
			43,5	

At Corley.

Castle Ring and Bardon Hill - -	72	32	45,75	
			46,25	46,5
			46,75	
			47	
Arbury Hill and Bardon Hill -	107	20	13,5	
			14,25	14,25
			15,75	

At Arbury Hill.

Corley and Bardon Hill - -	84	14	32,5	
			33,25	33,5*
			34,25	

Reduction of the Base to the Temperature of 62°.

The apparent length of the base was 259 chains of 100 feet each, + 8 chains of 50 feet each, and the overplus of the last chain *viz.* 38,321 feet - Feet. 26338,321

The chain B, before the measurement, was found to be $16\frac{1}{4}$ divisions on the micrometer-head shorter

* For the observations of the angles of the triangles southward of Arbury Hill, see the Philosophical Transactions for 1795 and 1800.

than A, the length of which, according to Mr. RAMSDEN's determination, may be taken = 100 feet + 0,1236 inches, in the temperature of 54°; which gives A 0,12363 parts of an inch too long. Therefore, if to this is added half the wear, *viz.* 0,00192 parts of an inch, we shall get $\frac{0,12555}{12}$, which × 259 gives 2,709 feet, which add - - - - + 2,709

The 50-feet chain, before the measurement, was compared also with B, and found to be 24 divisions on the micrometer-head longer; therefore, $\frac{0,0943}{12} \times 4$ = 0,0314 parts of a foot, which likewise add - + 0,031

Again, the sum of all the degrees shown on the thermometers was 98083, wherefore, $\frac{98083}{5} - 54° \times 263,38 \times \frac{0,0075}{12}$ = 3,3713 feet, is the correction for the mean heat in which the base was measured above 54°, the temperature in which the chains were laid off, and this also add - - - - + 3,371

Finally, for the reduction to the temperature of 62°, or 8° on the brass scale, we have $\frac{0,1237 \times 263,38 \times 8°}{12}$ = 1,720 feet, which subtract - - - — 1,720

Hence we have the true length of the base, in the temperature of 62°, = - - - 26342,712

Feet.

The surface of the ground on which this base was horizontally measured, is said to be not more than 35 feet above the surface of the sea, in the mouth of the Humber, at *half tide*. And, although it may not perhaps be a very correct deduction, yet, as I understand that conclusion arose out of a levelling operation, it may be taken for granted that we shall not err, as

to sense, in our conclusions, if we consider Misterton Carr as situated on the mean surface of the spheroid. I shall, therefore, take 26342,7 feet for the true length of the base; and I think it cannot exceed or fall short of that quantity, more than two inches.

Recent Comparisons of the standard and working Chains, with the points inserted in the cast Iron Bar.

In the reduction of the foregoing base, I have taken it for granted, that the standard chain is precisely of the same length as when it first came out of the hands of Mr. RAMSDEN. Circumstances which need not be mentioned in this part of my paper, but which, in their proper places, will be explained, have induced me to get both the long chains remeasured. Mr. BERGE, therefore, at my request, prepared the bar and plank, and lately went through the required operation. The particulars were as follow.

The chain B was first measured in five successive removes, the first space of 20 feet having a thermometer in the middle of the bar, which stood at 48°; the second space or remove, having the same thermometer at 48°,2; the third, at 48°,5; the fourth, at 48°,8; and the 5th, at 48°,8; which gave the total length of the chain = 100 feet + 0,077 parts of an inch, in the mean temperature of 48°,6.

The standard A was then measured in five successive removes; the thermometer at each remove being 48°,5 — 48°,6 — 48°,7 — 48°,8 — 48°,8; which gave the length of A = 100 feet + 0,132 parts of an inch, in the temperature 48,°7.

From the Table of expansions in Vol. LXXV. of the Phil. Trans. the difference between the expansion of a rod of steel

and one of cast iron, both of ten feet in length, is found to be 0,00001 part of an inch; therefore, the length of the chains, in the temperature of 54°, agreeing with the points on the bar, will be A = 100 feet + 0,1325 inches.

B = 100 feet + 0,0778 inches.

In the Phil. Trans. for 1795, page 437, their lengths, in the same temperature, as deduced by Mr. RAMSDEN, are stated to be A = 100 feet + 0,11425 inches.

B = 100 feet + 0,05825 inches; which gives a difference something less than $\frac{2}{100}$ of inch between their present and former lengths.

In the reduction of the preceding base, I have supposed the working chain A to be 0,12363 parts of an inch too long before the measurement began. If to this the whole wear be added, *viz.* 0,00384, we shall have the length of it, 100 feet + 0,1275 parts of an inch; which differs only $\frac{5}{1000}$ from the late determination of Mr. BERGE.

Calculation of the Sides of a Series of Triangles, extending from Dunnose, in the Isle of Wight, to Clifton, in Yorkshire. Plate XV.

In the former accounts of the trigonometrical operations it will be found, that triangles have been carried on from Dunnose to Arbury Hill. It will be proper to give them in this place, that the series may be complete, thereby superceding the necessity of frequently referring to those papers.

Butser Hill from Dunnose, 140580,4 feet. Phil. Trans. for 1795, p. 501.

No. of triangles.	Names of stations.	Observed angles.	Diff.	Spherical excess.	Error.	Angles corrected for calculation.	Distances.
		° ′ ″	″	″	″	° ′ ″	Feet.
I.	Butser Hill	76 12 22	—1,99			76 12 21,5	
	Dean Hill	48 4 32,25	—1,54			48 4 31,75	
	Dunnose	55 43 7	—1,53			55 43 6,75	
		180 0 1,25		5,0	—3,75		
	Dunnose from { Butser Hill						140580,4
	Dunnose from { Dean Hill						183496,2
II.	Dean Hill	62 22 48,75	—1,37			62 22 47	
	Butser Hill	48 28 41,5	—1,23			48 28 40	
	Highclere	69 8 35	—1,5			69 8 33	
		180 0 5,25		4,07	+1,18		
	Dean Hill from { Butser Hill						156122,1
	Dean Hill from { Highclere						125084,9
III.	Butser Hill	84 31 45,5	—1,2			84 31 44,5	
	Hind Head	66 15 54,5	—0,83			66 15 54,25	
	Highclere	29 12 22	—0,72			29 12 21,25	
		180 0 2		2,7	—0,7		
	Butser Hill from { Hind Head						78905,7
	Butser Hill from { Highclere						148031,0
IV.	Highclere	34 46 15,75	—0,81			34 46 15	
	Hind Head	83 20 14,25	—1,36			83 20 14	
	Bagshot Heath	34 46 15,75	—1,88			61 53 31	
		180 0 1,75		3,09	—1,34		
	Highclere from { Bagshot Heath						142952,6
	Highclere from { Hind Head						160972,2

No. of triangles.	Names of stations.	Observed angles.	Diff.	Spherical excess.	Error.	Angles corrected for calculation.	Distances.
		° ′ ″	″	″	″	° ′ ″	Feet.
V.	Bagshot Heath	55 32 26	—0,89			55 32 25,25	
	Highclere	46 10 18,25	—0,83			46 10 17,75	
	Nuffield	78 17 18,25	—1,20			78 17 17	
		180 0 2,5		2,94	—0,43		
	Nuffield from Bagshot Heath						105321,2
	Nuffield from Highclere						120374
VI.	White Horse Hill	63 7 53,25	—0,94			63 7 53,5	
	Highclere	63 18 16,75	—0,94			63 18 17	
	Nuffield	53 33 49,5	—0,86			53 33 49,5	
		179 59 59,5		2,74	—3,24		
	White Horse Hill from Nuffield						120557,7
	White Horse Hill from Highclere						108503,1
VII.	White Horse Hill	38 48 13,25	—0,67			38 48 12,5	
	Nuffield	86 4 16,25	—1,21			86 4 15	
	Brill	55 7 33,5	—0,71			55 7 32,5	
		180 0 3		2,6	+0,4		
	Brill from White Horse Hill						146603,2
	Brill from Nuffield						92805,5
VIII.	Brill	50 14 44,5	—1,18			50 14 45	
	White Horse Hill	64 45 43,75	—1,34			64 45 42,5	
	Stow on the Wold	64 59 32	—1,35			64 59 32,5	
		180 0 0,25		3,88	—3,63		
	Stow from White Horse Hill						124365,6
	Stow from Brill						146326,3
IX.	Brill	32 34 43	—0,61			32 34 42,25	
	Stow on the Wold	60 56 6,25	—0,64			60 56 5,5	
	Epwell	86 29 13,25	—0,11			86 29 12,25	
		180 0 2,75		2,37	+0,38		
	Epwell from Stow						78938,2
	Epwell from Brill						128140

No. of triangles.	Names of stations.	Observed angles.	Diff.	Spherical excess.	Error.	Angles corrected for calculation.	Distances.
		° ′ ″	″	″	″	° ′ ″	Feet.
x.	Brill - -	34 23 58,5	—0,65			34 23 57,5	
	Epwell - -	85 0 18,5	—1,10			85 0 17,5	
	Arbury Hill -	60 35 45,5	—0,70			60 35 45	
		180 0 22,5		2,46	+0,04		
	Arbury Hill from { Epwell - - -						83098,4
	{ Brill - - -						146530
xi.	Arbury Hill -	89 57 4,5	—1,14			89 57 5,5	
	Epwell - -	54 45 18,75	—0,57			54 45 18,25	
	Corley - -	35 17 36,75	—0,57			35 17 36,25	
		180 0 0		2,29	—2,29		
	Corley from - { Arbury Hill - -						117463
	{ Epwell - - -						143827,8

By the last triangle, the distance from Corley to Arbury Hill is 117463 feet, which distance, and all the others constituting the sides of this part of the series, are deduced from the base on Hounslow Heath, as well as that on Salisbury Plain. With regard to the triangles connecting the stations at Corley and Arbury Hill with the base recently measured in the north, it will be proper to let them rest partly on that base, and partly on the side Corley and Arbury Hill. And here I would remark, that in carrying on a series of triangles, whether for the purpose of a meridional measurement or otherwise, it is proper that a base of verification, answering at the same time as a new one of departure, should be measured every hundred miles at least. With this idea, therefore, the foregoing triangles, as well as those composing the remaining part of the series, should be furnished with three base lines, *viz.* one at each extremity, and the other in the middle. In calculating the sides, were the series thus

circumstanced, it would be right to depend on each base for one third of the distance between it and the one next at hand, and use the mean result, as derived from the two adjoining bases, for the true lengths of the several sides within the other third. Thus, if two bases were found at the extremities of the arc in question, and one in the middle, as about Brill, the computation should be carried on, from the extreme bases, about one-sixth part of the meridional distance; and, from the middle base, one-third of the intermediate distance on each side; the remaining two arcs being determined from the respective base lines. That I may avoid prolixity, or the appearance of it, I shall compute the sides of the triangles northward of the two stations before mentioned, from the base measured on Misterton Carr only, and use the mean distances calculated on the above principle, when I find the total length of my arc.

Length of the Base on Misterton Carr, 26342,7 Feet.

No. of triangles.	Names of stations.	Observed angles.	Diff.	Spherical excess.	Error.	Angles corrected for calculation.	Distances.
		° ′ ″	″	″	″	° ′ ″	Feet.
XII.	Beacon Hill -	20 47 19,75				20 47 20	
	North end of Base	60 17 16,5				60 17 13	
	South end of Base	98 55 27,5				98 55 27	
		180 0 3,75					
	Beacon Hill from { North end of Base -						64461,7
	{ South end of Base -						73321,9
XIII.	Beacon Hill -	34 44 42,25				34 44 42	
	North end of Base	74 46 56,5				74 46 56	
	Gringley on the Hill	70 28 22,25				70 28 22	
		180 0 1					
	Gringley from { North end of Base -						44338,2
	{ Beacon Hill -						75068,0

No. of triangles.	Names of stations.	Observed angles.	Diff.	Spherical excess.	Error.	Angles corrected for calculation.	Distances.
		° ′ ″	″	″	″	° ′ ″	Feet.
XIV.	Beacon Hill	13 57 24				13 57 23	
	Gringley	51 11 6,5				51 11 5	
	South end of Base	114 51 32,5				114 51 32	
		180 0 3					
		Gringley from Beacon Hill					75068,2
	Wherefore the mean distance from Gringley to Beacon Hill is 75068,1 Feet.						
XV.	Heathersedge	18 40 38,5	+0,29			18 40 38	
	Beacon Hill	138 9 16	−2,02			138 9 16	
	Gringley	23 10 6	+0,65			23 10 6	
		189 0 0,5		1,08	−0,58		
		Heathersedge from { Beacon Hill					92227,2
		{ Gringley					156384,8
XVI.	Sutton Ashfield	78 47 2	−1,01			78 47 1	
	Heathersedge	54 52 37,5	−0,24			54 52 35	
	Gringley	46 20 24	−0,22			46 20 24	
		180 0 3,5		2,45	+1,10		
		Sutton Ashfield from { Gringley					130399,7
		{ Heathersedge					115339,9
XVII.	Orpit	80 28 57,25	−0,85			80 28 57	
	Heathersedge	39 8 38,5	−0,12			39 8 38	
	Sutton Ashfield	60 22 25,5	−1,00			60 22 25	
		180 0 1		2,03	−1,03		
		Orpit from { Heathersedge					101660,3
		{ Sutton Ashfield					73826,6

No. of triangles.	Names of stations.	Observed angles.	Diff.	Spherical excess.	Error.	Angles corrected for calculation.	Distances.
		° ′ ″	″	″	″	° ′ ″	Feet.
XVIII.	Hollan Hill	44 43 32	—0,12			44 43 31	
	Sutton Ashfield	113 49 9	—0,53			113 49 7	
	Orpit	21 27 20,5	—0,18			21 27 22	
		180 0 1,5		0,73	+0,77		
	Hollan Hill from Sutton Ashfield						38375,2
	Hollan Hill from Orpit						95975,3
XIX.	Bardon Hill	42 58 59,5	—0,69			42 58 59	
	Hollan Hill	74 52 38	—1,03			74 52 37	
	Orpit	62 8 25	—1,01			62 8 24	
		180 0 2,5		2,75	—0,20		
	Bardon Hill from Hollan Hill						124454,7
	Bardon Hill from Orpit						135895,3
XX.	Castle Ring	55 32 44	—0,94			55 32 43	
	Bardon Hill	68 24 4,75	—1,02			68 24 3	
	Orpit	56 3 14,75	—0,90			56 3 14	
		180 0 3,5		2,85	+0,65		
	Castle Ring from Orpit						153235,2
	Castle Ring from Bardon Hill						136717,8
XXI.	Corley	72 32 46,5	—1,19			72 32 46	
	Castle Ring	47 54 42,25	—0,86			47 54 42	
	Bardon Hill	59 32 32,25	—0,94			59 32 32	
		180 0 1		2,93	—1,93		
	Corley from Bardon Hill						106357,3
	Corley from Castle Ring						123539,7
XXII.	Arbury Hill	34 14 33,5	—0,98			34 14 33	
	Corley	107 20 14,25	—1,99			107 20 14	
	Bardon Hill	38 25 13,25	—0,80			38 25 13	
		180 0 1		3,37	—2,37		
	Arbury Hill from Bardon Hill						180426,0
	Arbury Hill from Corley						117457,1

From the last triangle, we get 117457,1 for the distance between Corley and Arbury Hill. By the XI. triangle, the distance between those stations is 117463 feet; there is, therefore, a difference of nearly six feet between the two determinations; a quantity which cannot be considered unexpectedly great, as the side is more than twenty-two miles in length, and the whole series nearly two hundred miles long. If the computation had been carried on from Dunnose all the way up, the bases on Hounslow Heath and Salisbury Plain would have given the length of that on Misterton Carr about one foot greater than its measured extent. If the sides of the triangles contiguous to Corley and Arbury Hill be recomputed, from the mean distance between those stations, *viz.* 117460 feet, no doubt whatever can be justly entertained of the general accuracy of the whole. These mean distances, as I have before observed, will be used in the calculations of the total length of the meridional arc. From the Base in the north, I have numbered the triangles downwards: the reason is obvious.

Calculation of the meridional Distance between Dunnose and Clifton.

To do this, it will be right to compare the distances of the several stations from the respective perpendiculars, both of Dunnose and Clifton, as derived from the observed direction of each meridian.

In the Phil. Trans. for 1795 it will be seen, that the direction of the meridian was observed at the station on Dunnose, in 1793, the staff to which the pole star was referred being placed on Brading Down. The angle between that staff and the meridian, (see page 517 of that volume,) was found to be 21° 14′ 11″,5, as

derived from two double azimuths of the star, supported by several computed azimuths, applied to single but accurate observations.

The angle between Butser Hill and the staff at Brading Down, was 0° 15′ 35″,5. This, with the above angle, 21° 14′ 11″,5, and particular angles of the series, gives,

The Bearings of certain Sides from the Parallels to the Meridian of Dunnose.

Dunnose and Butser Hill -	20°	58′	39″	NE
Butser Hill and Highclere -	34	20	17	NW
Highclere and Nuffield - -	35	30	40	NE
Nuffield and Brill - -	4	51	15	NW
Brill and Arbury Hill - -	12	30	17	NW
Arbury Hill and Bardon Hill -	7	42	57	NW
Bardon Hill and Orpit - -	21	21	9	NW
Orpit and Heathersedge -	5	25	52	NW
Heathersedge and Beacon Hill -	61	52	17	NE.

These bearings, and the respective sides, give the following distances on the meridian of Dunnose, *viz.*

	Feet.	Miles.
Dunnose and Butser Hill -	131263,0 =	24,86
Butser Hill and Highclere	122232,7 =	23,15
Highclere and Nuffield -	97984,7 =	18,56
Nuffield and Brill - -	91755,3 =	17,38
Brill and Arbury Hill -	143054,1 =	27,09
Arbury Hill and Bardon Hill	178792,4 =	33,86
Bardon Hill and Orpit -	126567,8 =	23,97
Orpit and Heathersedge -	101203,7 =	19,17
Heathersedge and Beacon Hill	43480,7 =	8,23
	1036334,4 =	196,27, the distance

between Clifton and the perpendicular to the meridian of Dunnose; which may be taken for the true length of the arc itself, as the distance of the former station from the meridian of the latter, is only 4770 feet.

If the angle between the meridian and the staff at Brading Down was observed accurately, there can be no doubt of the correctness of this determination; but, as it was right on my part to adopt measures for bringing it to some proper test, I observed, as before stated, the direction of the meridian at Clifton. The particulars were as follows.

Observed Angles between the Pole Star, when at its greatest Elongations from the Meridian of Clifton, and the Staff erected over the Station at Gringley on the Hill.

August, 1801.

Days.	Evenings.	Mornings.
9th. -	100° 45′ 46″	
10th. -	100 45 43,5	
11th. -	100 45 45,5	106° 39′ 34″
13th. -	100 45 39	106 39 22
16th. -	100 45 40,5	
17th. -	100 45 41	106 39 24
18th. -	100 45 39	106 39 28
19th. -	100 45 46,5	106 39 27.

If a mean of all the evening observations be taken, we shall get 100° 45′ 42″,8, for the angle between the staff at Gringley and the star when at its greatest eastern elongation from the merdian. In like manner, if a mean of all the morning observations be taken, we shall have 106° 39′ 27″, for the angle between the same staff and the star on the western side. Hence, half their

sum, 103° 42′ 35″, nearly, will be the angle between Gringley and the meridian of Clifton; and its south-eastern bearing 76° 17′ 25″. This, with certain angles of the series, gives the bearings of the following sides, *viz.*

Beacon Hill and Heathersedge -	61°	51′	50″	SW
Heathersedge and Orpit - -	5	26	19	SE
Orpit and Bardon Hill - -	21	21	36	SE
Bardon Hill and Arbury Hill -	7	43	26	SE
Arbury Hill and Brill - -	12	31	0	SE
Brill and White Horse Hill -	50	15	48	SW
White Horse Hill and Highclere	27	48	6	SE
Highclere and Butser Hill - -	34	20	49	SE
Butser Hill and Dunnose -	20	58	9	SW.

These bearings and sides give the following parallels to the meridian of Clifton.

	Feet.
Beacon Hill and Heathersedge	43490,4
Heathersedge and Orpit -	101202,6
Orpit and Bardon - -	126561,3
Bardon Hill and Arbury Hill -	178793,2
Arbury Hill and Brill -	143047 4
Brill and White Horse Hill -	93717,6
White Horse Hill and Highclere	96031,4
Highclere and Butser Hill -	122219,8
Butser Hill and Dunnose -	131270,2

The sum, 1036333,9 feet, is the distance between Dunnose and the perpendicular to the meridian of Clifton; or, as observed with regard to the sum of the parallels to the meridian of the former, the length of the arc itself.

There is, therefore, a difference of only half a foot, between the two results. We may, consequently, take 1036334 feet, for the distance required.

I have observed, in a former part of this account, that the zenith sector was placed $6\frac{1}{2}$ feet from the station at Dunnose, and $3\frac{1}{2}$ feet from that at Clifton, the new points being due south of the old. We must therefore add 3 feet to 1036334; which gives 1036337 feet, for the total length of the arc of the meridian.

The sum of the parallels to the meridian of Clifton, reaching down to Arbury Hill, is 450047,5 feet; and the distance of the latter from that meridian 1996 feet. This is, in fact, the meridional extent between the two old stations, as no correction is requisite. We must, however, subtract 30 feet from this distance, as the sector was put up $34\frac{1}{2}$ feet northward of the station on Arbury Hill. Therefore, $450047{,}5 - 30 = 450017{,}5$ feet, is the length of the arc comprized between the parallels of the new stations at Clifton and Arbury Hill: and, subtracting this from 1036337, we have 586319,5 feet, for the distance of this latter station from the point over which the sector was placed at Dunnose.

Although the zenith sector was taken to the Royal Observatory at Greenwich, rather with a view of collecting materials for finding the latitude of Dunnose, than to answer any other purpose, yet, as I am provided with the means of finding the meridional distance between those places, and that with sufficient accuracy, I shall go through the work in this place.

Distance between the Parallels of Latitude of Greenwich and Dunnose.

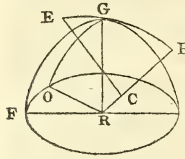
In the Phil. Trans. for 1795, the station on Beachy Head is shown to be 269328 feet from the perpendicular at Greenwich, and 58548 from its meridian. In Plate XVI. Fig. 2, of this account, let DPB be a great spheroidical triangle on the earth's surface, P the pole, and D B the two stations at Dunnose and Beachy Head. Let also PGM be the meridian of Greenwich, [G,] and M the point where the parallel of Beachy Head to the perpendicular at G cuts that meridian. Then, from the above values of GM and BM, it will be found, that the latitude of B is 1″,03 less than the latitude of M, and that too on any hypothesis of the earth's figure. Therefore, the distance in feet, between the parallels of B and G, is $269328 + 103 = 269431$.

Now it has been shown, in the volume above referred to, (see page 522,) that the meridional distance between D and B is the mean of the two numbers 44258,6 and 44258,9 feet; and it must be remembered that, in deducing those conclusions, recourse was not had to matters of assumption, but to matters of fact, which were, the observed directions of the two meridians PD, PB, and the distance DB. Therefore, if 44259 feet be taken for the meridional distance between D and B, we shall have $269431 + 44259 = 313690$ feet, for the space between the parallels of latitude of Greenwich and Dunnose.*

* In the Phil. Trans. for 1800, (see note to page 641,) in finding the value of the oblique arc between Black Down, in Dorsetshire, and Dunnose, I have used the expression $\frac{pm}{p + m - s \cdot s^2} = d$; where d is the length of the required degree, p that of the great circle perpendicular to the meridian, m that of the degree of the meridian itself, and s the sine of the angle constituted by the oblique arc and the meridian.

We have then found the total length of the whole meridional arc, and also the distances of two intermediate points from either, or from both, of its extremities. And, to bring the whole

The demonstration of this rule I did not insert, on account of the previous length of the note alluded to; but I take this opportunity of supplying the omission, in the words of Mr. DALBY.



Having the length of the degree on the meridian, and also that of the degree perpendicular to it, at the same point; to find the length of a degree in any other given direction, supposing the earth to be an ellipsoid.

Let EP be one-fourth of the elliptic meridian; C the centre of the earth; CE, CP, the equatorial and polar semiaxes; G a given point on the meridian EP. Draw GR perpendicular to the meridian at G, meeting the axis PR in R; then RG is the radius of curvature of the ellipse, at the point G, which is perpendicular to the meridian at G.

Conceive another ellipsoid FGSO to touch the given one in the point G. Then, it is evident, that if the curvature be respectively the same in the direction of the meridian and the perpendicular, on both ellipsoids at the point G, the curvature will also be equal on both figures, in any other direction at that point. And the like is manifest in spheroids of any other kind.

Let M be the radius of curvature of the meridian at the point G; then, because RG is the radius of curvature in the perpendicular direction, if we take FS (at right angles to RG) $= 2\sqrt{RG \times M}$, and about FS, the axis to the semidiameter RG, describe the ellipsoid FGSO, it will be *that* having the curvature of G the same as on the other ellipsoid at that point.

Let OGR be the plane of an ellipse, inclined to the meridian EGP, or to the plane FGS, in a given angle FRO, whose *sine* and *cosine* are s and c. Then, since RG, or rather its equal, is a semitransverse, in the plane FOSR, (which is perpendicular to RG,) to the semiconjugate RF, we shall have $\frac{RG^2 \times RF^2}{RG^2 c^2 + RF^2 s^2} = RO$, which, divided by RG, (RG being the semitransverse to RO in the perpendicular plane ROG,) gives $\frac{RG \times RF^2}{RG^2 c^2 + RF^2 s^2}$ for the radius of curvature of the inclined ellipse OG at the point G. But, because the lengths of the degrees are proportional to their radii of curvature, if we put m and p for the meridional and perpendicular degrees, then RF or $\sqrt{RG \times M}$ and RG may be expounded by $\sqrt{pm}$, and p; hence, the expression will become $\frac{pm}{pc^2 + ms^2}$, for the length

under one point of view for future use, we shall have the following

Arcs.

	Feet.	Miles.
1. Clifton and Dunnose -	1036337 =	196,27
2. Dunnose and Arbury Hill -	586320 =	111,05
3. Dunnose and Greenwich - -	313696 =	59,41
4. Clifton and Arbury Hill -	450017 =	85,23
5. Clifton and Greenwich - -	722641 =	136,86
6. Arbury Hill and Greenwich -	272624 =	51,63

Remark.

In calculating the distance between the parallels of latitude of two places, connected by means of a trigonometrical operation, regard must be had to their difference in longitude. If the triangles run nearly north and south, in which case stations must lie both east and west of the two meridians, it is sufficiently correct to proceed on the supposition of the earth's surface being a plane; but if, on the contrary, the triangles wholly diverge from the two meridians, or even partly do so, first running off obliquely and then returning again, a different

of the degree oblique to the meridian; or, putting $1 - s^2$ for c^2, and r for $p - m$, it will be $\frac{pm}{p - rs^2}$.

Corol. If d be the length of the oblique degree, then, since $d = \frac{pm}{pc^2 + ms^2}$, we have $p = \frac{s^2 dm}{m - c^2 d}$, and $m = \frac{c^2 dp}{p - sd^2}$. And, if D be put for the length of another oblique degree at the same point, and S and C the *sine* and *cosine* of its inclination to the meridian, we shall get $m = \frac{S^2 c^2 - C^2 s^2}{S^2 D - s^2 d} \times D d$, and $p = \frac{S^2 c^2 - C^2 s^2}{c^2 d - C^2 D} \times D d$, the meridional and perpendicular degrees, exhibited in terms of the oblique degrees combined with the sines and cosines of their inclinations to the meridian. Therefore, an ellipsoid may be determined from the lengths of two oblique degrees in the same latitude.

We may likewise remark, from the nature of radii of curvature, at the same point G, that the expression $\frac{pm}{p - rs^2}$ will also give the oblique degree on different spheroids.

method must be pursued. The necessity giving rise to this, originates from the radii of curvature of the oblique degrees continually varying, and the angles of convergency, between the several sides and their respective meridians, remaining unknown.

It must be remembered, that the sides of the several triangles projected over the country, in this Survey, are not to be considered as so many distances on the earth's surface, but the lengths of the chord lines subtended by arcs. Therefore, it is manifest that, strictly speaking, all the chord angles should be used, and not the horizontal ones; with which, after the bearing of the first side with the meridian has been reduced to some plane beneath the earth's surface, a number of chord lines in the plane of that meridian are to be computed; the sum of which, augmented by the differences between those chords and their respective arcs, will give the true meridional distance. I have been at the trouble to calculate the distance between Clifton and Dunnose on this principle; and find the length of my arc to be 1036339,5 feet; which is, about $2\frac{1}{2}$ feet more than the distance determined by the other mode of computation. An advantage, however, attending a calculation on the principle now spoken of, is the ability of calculating, pretty nearly, the azimuth of any one station from an extremity of the arc. This, if the instrument with which the direction of the meridian is observed be not well divided, or otherwise not exactly fit for the operation, is necessary, and should be always done. The angle at Clifton, between Gringley on the Hill and the meridian, was observed to be 76° 17′ 25″. According to my computation in the way spoken of, that angle is 76 17′ 30″. A difference of 5″, working all the way up from Dunnose through an arc of 2° 50′, is as small as can be expected, and serves to prove that the angles of

the triangles, as well as the observed direction of the meridians, are consistent. I have given the meridional distance between Clifton and Dunnose, bearings of the sides, &c. deduced from the most simple of the two methods; first, because the result is sufficiently accurate; secondly, because it places within general reach, the means of examining this part of my operation. In attending to this remark, it must be remembered, that a line from Dunnose perpendicular to the meridian of Clifton, is only 4853 feet.

SECTION SECOND.

Operations at the Station on Dunnose, the Southern Extremity of the Arc, with the Zenith Sector. May and June, 1802.

On the 8th of May, the circular or large theodolite was placed over the point selected for a new station: its distance was $6\frac{1}{2}$ feet from the gun, and in a direction due south. The following objects were then observed, the readings of which, on the graduated limb, were as follows.

Sir R. Worsley's obelisk (the top) -	113° 14′ 28″
East Cowes sea mark - - -	1 46 36,5
Luttrell's Folly - - -	177 56 25
Vane on the top of Portsmouth Church	40 6 44,5
Sir R. Worsley's obelisk, a second time	113 14 24,25

The above objects were observed, in order that no possible mistake might result; as (though not probable) accidental circumstances might have given rise to a wrong statement of the bearing of some one of the number, (except Portsmouth Church,) in the account of 1795. Omitting the obelisk, the

bearings of the other objects, as extracted from that Paper, will be as follows.

Luttrell's Folly	23°	0′	44″	NW	from the meridian of Dunnose.
East Cowes sea mark	19	11	19	NW	
Portsmouth Church	19	9	40	NE	

If, from the readings on the limb, the angles between the obelisk and the other objects be taken, and applied to the last-mentioned bearings, we shall get the angle between the obelisk and the meridian, 87° 42′ 40″ / 35 / 45 } Mean, 87° 42′ 40″.

May 9th. Erected the observatory, drove four long stakes into the ground, and brought their several heads into the same horizontal plane. Then erected the stand, set up the sector, and adjusted the axis level, and the axis itself; determined the exact weight the plumb-line would bear, and then examined how much the cross wires were out of their proper positions, as follows.

The stand being firmly screwed down to the stakes, the sector was turned on its axis, till the pointed top of Sir Richard Worsley's obelisk appeared in the field; it was then clamped to the azimuth circle, but subject to a small motion by turning an adjusting-screw. The pointed apex was then made to appear as just vanishing under the wires; in which situation of things, the side telescope was turned round, and laid in its several positions on the brass frame attached for its reception to the side of the sectorial tube; the top of the obelisk appearing as a vanishing point under the wires. On whichever face of its squares it was made to rest, the vernier of the azimuth circle read off to 84° 5′. The little telescope was then taken out of its frame, and the

sector turned half round. It was then again introduced into its supports, and the interior stand moved, till the wires in the focus of the lateral telescope appeared on the obelisk as before. The vernier was then examined, which again stood at 84° 5′. This being settled, the sector was turned round, till its vernier stood at 176° 22′ on the azimuth circle, in which situation, the plane of the divided arc was necessarily parallel to that of the meridian. The task of observation then commenced, and the performance of it was as follows.

Observations made at Dunnose, to determine the Zenith Distance of β Draconis.

Point on the Limb, 1° 50′ North.

Day of the month.	Face of the arch, W. or E.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Thermometer. Below.
1802		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
May 11	W	9 4,82	9 17,9	1 50 0 13,08	1 49 46,90	28.85	43,5	43,5
13	E	9 16,95	8 56,0	19,95	40,02	28,85	36,5	38,0
14	W	9 34,25	9 47,5	13,25	46,73	28,92	34,5	34,5
16	E	8 32,16	8 14,0	18,16	41,81	28,82	35,5	34,5
June 5	W	6 23,00	6 30,0	7,00	52,99	28,45	51,5	51,5
8	E	8 14.02	8 2,0	12,02	47,96	28,49	52,0	51,8
11	W	6 57,40	7 2,6	4,20	55,79	28,54	52,5	52,0
13	E	9 39,50	9 29,5	10,00	49.98	28,79	53,0	52,7
14	W	8 19,29	8 23,7	4,41	55,58	28,86	54,2	53,0
16	E	3 56,61	3 47,0	9,61	50,37	28,75	59,5	60,0
17	W	8 38.52	8 41,5	2,98	57,02	28,82	56,1	58,0
18	E	11 31.87	11 21,5	10,37	49,61	28,81	52,0	51,0
20	W	8 53,27	8 54,2	0,93	59,07	29,03	57,5	58,0
21	E	10 27,05	10 19,7	7,35	52,64	28,99	56,5	55,5

Observed Zenith Distances of γ Draconis.

Point on the Limb, 0° 50′ North.

Day of the month.	Face of the arch, W or E.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
May 10	E	10 15,52	13 48,1	0 50 3 32,75	0 53 30,10	29,0	—	45,0
11	W	9 38,66	5 56,4	41,26	38,62	28,85	43,9	43,5
13	E	8 47,30	12 81,4	34,10	31,45	28,85	36,5	38,0
14	W	7 32,38	3 49,2	42,18	39,54	28,92	34,5	34,5
16	E	9 40,00	13 15,2	34,22	31,55	28,82	35,5	37,5
June 11	W	7 20,70	3 29,5	50,20	47,58	28,34	53,5	52,5
13	E	9 36,35	13 20,3	42,95	40,31	28,79	52,5	52,3
14	W	8 25,26	4 33,4	50,86	48,24	28,26	51,3	53,0
16	E	9 48,33	14 37,4	45,07	43,44	28,75	59,5	60,0
17	W	8 32,66	4 39,4	52,26	49,64	28,82	56,0	58,0
18	E	11 32,77	15 17,9	44,13	41,50	28,8	52,0	51,0
20	W	8 9,48	4 17,0	51,48	48,86	29 97	58,6	57,0
21	E	11 52,92	15 40,0	47,08	44,45	28,83	56,0	55,5

Observed Zenith Distance of 45 d Draconis.

Point on the Limb, 6° 15′ North.

June 13	E	9 27,76	10 53,1	6 15 1 25,34	6 16 24,48	28,8	49,5	51,0
14	W	9 23,81	7 48,5	34,31	33,30	28,86	54,0	53,0
16	E	10 18,90	11 46,5	27,60	26,74	28,77	59,0	59,5
18	W	11 11,65	9 32,9	37,75	36,91	28,8	58,5	52,7
20	E	8 18,20	9 46,7	28,50	27,64	28,97	56,0	55,5
21	W	11 31,03	9 52,7	37,33	36,49	28,99	56,0	55,5

Observed Zenith Distance of 46 c Draconis.

Point on the Limb, 4° 40′ North.

June 13	E	9 34,85	12 46,0	4 40 3 11,15	4 43 8,46	28,8	49,5	51,0
14	W	8 16,17	4 53,0	20,17	17,50	28,86	51,7	50,5
16	E	13 15,62	16 27,0	11,38	8,69	28,77	59,0	59,5
18	W	11 10,40	7 41,3	18,10	15,42	28,8	52,7	50,5
20	E	8 32,10	11 47,0	14,90	12,22	28,97	58,4	57,0
21	W	11 5,13	7 43,1	21,03	18,36	28,99	56,0	55,5

Observed Zenith Distance of 51 *Draconis.*

Point on the Limb, 2° 25′ *North.*

Day of the month	Face of the arch, W. or E.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
June 13	E	7 42,00	13 11,5	2 20 3 28 50	2 23 25,84	28,8	49,5	51,0
14	W	8 10,63	4 33,3	36,33	33,68	28,9	51,8	50,5
16	E	9 0,00	12 28,8	28,80	26,14	28,8	59,0	59,5
18	W	10 48,27	7 11,5	36,77	34,12	28,8	50,2	50,0
20	E	8 47,43	12 21,0	32,57	29,92	29,0	55,0	56,0
21	W	11 2,23	7 24,5	36,75	34,08	29,0	53,5	55,0

Observed Zenith Distance of μ *Draconis.*

Point on the Limb, 4° 5′ *North.*

May 11	W	9 18,20	7 31,6	4 5 1 45,60	4 6 44,73	28,85	43,5	43,5
13	E	13 3,04	11 39,0	46,01	35,17	28,85	40,5	41,0
14	W	10 2,03	8 18,4	42,63	41,80	28 92	36,3	38,5
June 8	E	8 12 56	9 57,1	44,54	43 71	28,51	51,5	51,0
13	E	9 29,34	11 15,8	45,40	44,63	28,79	53,5	51,5
14	W	8 29,50	6 34,7	53,86	53,05	28,86	53,5	54,0
16	E	4 9,00	5 50,0	46,34	45,51	28,75	59,5	60,0
17	W	8 45,33	6 50,5	53,83	53,02	28,82	56,0	58,0
18	E	11 44, 3	13 34,0	48,17	47,35	28,80	52,0	51,1
20	W	8 44,96	6 47,0	54,96	54,15	29,0	58,2	58,0
21	E	10 34,60	12 25,0	49,40	48,58	28,99	55,8	55,5

Observed Zenith Distance of 16 *Draconis.*

Point on the Limb, 2° 40′ *North.*

May 11	W	10 2,08	7 43,0	2 40 2 18,08	2 42 16,30	28,85	43,5	43,5
14	W	10 27,15	8 9,0	18,15	16,37	29,92	36,5	37,2
16	W	8 31,87	6 14,0	17,87	16,09	28,82	39,0	39,9
June 5	W	9 38,25	7 11,5	26,75	24,99	28,54	53,5	52,0
13	E	4 28,90	1 48,3	39,60	37,86	28,86	52,0	51,5
14	W	8 31,63	6 4,0	27,63	25,87	28,86	53,5	54,0
16	E	3 51,90	6 14,5	21,60	19,83	28,78	61,0	60,2
18	E	11 28,70	13 50,1	21,40	19,63	28,80	51,5	52,7
20	W	8 25,61	5 55,2	29,41	27,65	28,95	57,7	58,5

Observed Zenith Distance of 1 *κ Cygni.*
Point on the Limb, 2° 20′ *North.*

Day of the month.	Face of the arch, W. or E.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above	Thermometer. Below
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
June 13	E	9 26,60	12 33,5	2 20 3 6,90	2 23 4,20	28 8	50,0	50,5
14	W	5 54,98	2 37.0	17,98	15,30	28.9	52,1	50,0
16	E	8 49.45	6 52,9	1 55,55	5,26	28,8	59 9	59.0 •
18	W	10 12,05	6 58,8	2 20 3 16,25	13.57	28,8	50,1	50,0
20	E	9 9,83	12 20,0	10,17	7,48	29,0	54,9	56,1 •
21	W	11 1,83	7 44.2	16,63	13,95	29,0	55,0	53,5

• Point on the limb 2° 25′.

Observed Zenith Distance of 10 *ι Cygni.* ‡
Point on the Limb, 0° 40′ *North.*

June 13	E	9 30,95	10 55,2	0 40 1 24.25	0 41 23,39	28,8	50,0	50,5
14	W	0 50,05	4 51,8	32,25	31.40	28,9	51,7	50,5
16	E	8 43.00	10 9,5	25,50	24,64	28,8	60,0	59,0
18	W	9 38.90	8 26 0	32.90	32,05	28,8	50,2	50,0
20	E	8 30,78	10 0,0	28,22	27,36	29.1	55,0	56,0
21	W	11 19.80	9 45,1	33,70	32,85	28,9	55,0	55,5

Observed Zenith Distance of γ *Ursæ.*
Point on the Limb, 4° 10′ *North.*

May 9	E	11 42,53	12 14 6	4 10 0 31,07	4 10 31,12	—	—	—
10	E	11 10,60	11 42,5	31,90	31,95	29,0	52,0	52,0
11	W	8 34.32	7 54 4	38,92	38,98	28,8	50,5	51,5
13	E	9 54,86	10 29.5	33.64	33,69	28,8	45,7	44.3
14	E	10 1,47	10 34.5	33,03	33,08	28 9	38,5	38,5
15	W	7 15 49	6 33,6	40,89	40,96	28,9	41,0	41,5
17	E	8 54 00	9 29 5	34,50	34,56	28.8	46,0	42,5
20	E	13 43,03	14 18,1	34,07	34,13	28,7	50,5	51,0
June 5	W	9 21,10	8 35.5	43.60	43,67	28,4	53,0	55,1
8	E	8 58.90	9 36,2	37,30	37,36	28,5	55,5	58,5
12	E	5 46,50	6 22.4	34,90	34,96	28,6	54,0	54,0†
13	W	10 40,70	9 56.4	43,30	43,37	28,7	59,1	59,0
14	W	7 16.40	6 53,0	42,40	42,47	28,9	60,4	59,3
16	E	9 3,20	9 41,1	38,00	38,06	28,8	72,0	69,5

† Imperfect observation.

‡ In page 417, 10 ν Cygni should be 10 ι, ξ Ursæ should be ζ, 85 ν Herculis should be 85 ι, and υ Herculis should be ν.

Observed Zenith Distance of η Ursæ.
Point on the Limb, 0° 15′ South.

Day of the month.	Face of the arch. W. or E	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts	Zenith distance reduced.	Barometer.	Thermometer. Above.	Below
		ev. div.	rev. div.	° ′ rev. div	° ′ ″	Inches.	°	°
May 10	E	10 6,74	6 8,6	0 15 3 57,14	5 18 54,53	29,0	49,1	49,0
13	E	9 48,22	5 49,1	58,12	55,51	28,9	40,5	41,0
14	W	10 47, 4	14 39,6	50,86	48,24	28,9	30,5	38,5
15	E	10 9,99	6 11,1	57,89	55,26	28,9	41,0	41,5
16	W	9 13,31	13 5 0	50,69	48,07	28,8	39,0	39,9
17	E	9 0,46	5 3,2	56,26	53,65	28 8	46,0	42,5
June 5	W	7 58,15	11 46,3	47,11	44,52	28,5	52,3	52,3
8	E	9 6,37	5 11,6	53,72	51 10	28,5	52,0	56,0
11	W	9 28,50	13 12,7	43,20	40,57	28,5	52,0	55,5
12	E	5 32,60	1 59,0	52,60	49 98	28,6	57,5	50,0
13	W	10 14,50	14 4 0	48,50	49,87	28,7	56 5	56,5
14	E	7 47,52	4 0,4	47,12	44,49	28,8	57,0	56,5 •
16	W	9 4,21	12 49,7	45,49	42,86	28,8	64,0	63,5
18	W	9 14,50	13 0,5	45,00	42,37	28 8	50,5	57,5
20	E	9 6,03	5 13,9	51,13	48,41	28,8	67,0	70,5
21	E	12 45,00	8 57,5	50,50	47,87	28,9	55,5	56,•

• Doubtful.

Observed Zenith Distance of ζ Ursæ.
Point on the Limb, 5° 20′ North.

May 11	W	9 19,98	8 44,3	5 20 0 34,68	50 20 34,74	28.8	48.9	49,5
13	E	9 37,00	10 5.5	27,50	27,54	28,8	45,1	44,1
17	E	8 49.96	9 20,5	29,54	29.59	28 8	46,0	42,3
June 5	W	8 31 92	7 51,9	39,02	39 08	28,5	52,3	52,3
8	E	8 56,50	9 28,1	30,60	30,65	28,5	52,0	56,0
11	W	9 36,93	8 55,6	40,33	40,00	28,5	54,0	55,0
14	E	7 47,74	8 23,0	34,26	34,32	28,5	60,5	59,5
17	E	9 33,12	10 8,2	34,08	34 14	28,8	64,0	65,0
18	W	9 28,30	8 45,0	42,30	42,37	28,7	57,5	59,5
20	E	8 54,12	9 30,2	35,08	35,14	28,8	67,0	70,5

Observed Zenith Distance of 85 ι Herculis.
Point on the Limb, 4° 25′ South.

May 10	E	15 16,87	9 50,6	4 25 5 25,27	4 30 20,80	29.0	45,5	45.5
13	E	8 28,70	3 2,5	26,20	21.73	28,8	40,5	41,0
14	W	8 24.16	13 43,0	18,84	14.36	28 9	34,5	34.5
16	E	9 36,40	4 11,2	25,20	20,23	28.8	35,5	35.5
June 14	W	8 25,36	13 33,6	8,24	3,74	28,8	54,0	53,•

Observed Zenith Distance of υ Herculis.

Point on the Limb, 4° 0′ South.

Day of the month.	Face of the arch, W. or E.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above	Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
May 11	W	9 25,06	10 55,0	4 0 1 29.94	4 1 29,09	28,8	43,5	43,5 *
13	E	10 3.86	8 12,2	50.66	49,84	28,8	40,5	41,0
14	W	9 44,22	11 27,6	42,38	41,55	28,9	34,5	35,5
16	W	2 56,33	4 40,3	42,97	42,14	22,8	39,0	39,9
June 5	W	6 25,10	8 3,6	37,50	36,66	28,4	50,5	51,0
11	W	9 26,10	11 21,0	53,90	53,09	28,5	53,5	52,0
13	E	9 58,25	8 17,0	41,25	40,42	28,8	52,0	51,5
14	W	9 27,50	11 3,5	35,00	34,16	28,7	54,7	54,5
16	E	3 53,47	2 13,0	40,47	39,63	28,8	61,0	60,2
18	E	11 42,00	13 23,0	40,00	39,17	28,8	51,5	52,7
20	E	9 34,90	7 53,4	40,50	39,66	28,9	57,7	52,5

* Imperfect observation.

Observed Zenith Distance of 52 Herculis.

Point on the Limb, 4° 15′ South.

May 13	E	9 52,55	7 32,0	4 15 2 20,55	4 17 18,78	28,8	40,5	41,0
14	W	10 16,56	12 30.4	13.84	12,06	28,92	34,5	35,5
16	E	8 21,44	6 1,6	19.84	18,07	28,8	39,0	39.9
June 8	E	8 9,40	5 55,0	13,40	11,62	28,5	52,5	55,5
11	W	9 29.24	11 34,5	5,26	3,46	28,5	53,5	52,0
13	E	9 33,39	7 21,4	11.99	10,20	28,8	53,5	51,5
14	W	8 28,36	10 32,2	3,84	2,04	28,7	53,5	54,0
16	E	9 8,60	6 56,5	11,11	9,32	28,8	59,5	60,0
17	W	8 57,87	11 4,0	5.13	3,33	28,8	57,5	58,0
18	E	11 39,57	9 31,1	8,47	6 68	28,8	51,5	52,7 †
20	W	8 44 61	10 48,0	3,39	1,59	28,9	57,7	58,5
21	E	10 7,00	7 56,4	9,60	7,81	28,9	59,5	57,5

† Imperfect observation.

Observed Zenith Distance of 22 τ Herculis.

Point on the Limb, 3° 45′ South.

Day of the month.	Face of the arch, W. or E.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above	Thermometer. Below
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
May 10	E	11 1,72	6 0,7	3 45 5 1,02	3 49 56,51	29.0	—	49,0
11	W	9 28,35	14 21,1	4 51,75	48,23	28,8	43,5	43,5
13	E	9 56,10	4 57,0	58,10	54,59	28,8	40,5	41,0
14	W	10 26,95	15 17,8	49,85	46,32	29,9	36,5	38,5
16	W	8 27,50	13 19,0	50,50	46,98	28,8	39,0	39,9
June 5	W	6 24,95	11 10,2	44,25	40,72	28,4	50,5	51,0
8	E	8 46,08	3 50,7	49,38	45,85	28,5	50,5	52,5
11	W	9 31,31	14 14,4	42,09	38,55	28,5	53,5	52,0
13	E	9 35,50	4 46,5	48,00	44,47	28,8	52,0	51,5
14	W	9 3,82	13 45,7	41,88	38,34	28,8	53,5	54 0
17	W	8 37,38	13 19,6	41,22	37,68	28,8	57,5	58,0
18	E	11 41,16	6 53,5	46,66	43,11	28,8	51,5	52,7
20	W	8 44,15	13 27,0	41,85	38,31	28,9	57.7	58,5
21	E	10 22,13	5 34,3	46,83	43,30	29,0	59,5	57,6

Observed Zenith Distance of Capella.

Point on the Limb, 4° 50′ South.

May 11	E	10 37,73	10 29,0	4 50 0 8,73	4 50 8,74	28,9	64,0	65,1
12	W	9 16,65	9 18,2	1,55	1,55	28,7	63,5	66,0
13	E	9 42,06	9 34,4	7,66	7,67	28,8	57,4	54 9
15	W	8 38,83	8 39,4	0,57	0,57	28,7	53,0	58,1
June 8	W	8 39,52	8 42,5	2,98	2,98	28,4	63,2	60,1
11	E	9 6,74	8 53,0	12,74	10,54	28,4	65,5	62,5
15	W	10 26,53	10 31,4	4,87	4,88	28,8	78,0	73,0
16	E	8 48,20	8 31,5	16,70	16,73	28,7	72,0	69,5
21	W	12 24,35	12 30,9	6,55	6,56	28,8	71,0	68,5
22	W	5 48,86	5 52,9	4,04	4,05	28,6	86,0	79,1

Operations at the Station near Clifton, the northern Extremity of the Arc, with the Zenith Sector. July and August, 1802.

On the 19th of July, the observatory and zenith sector were erected at the station, and the angle between the spindle of the weathercock on Laughton Spire and a staff at Gringley on

the Hill, was observed on different arches of the large theodolite; the results being as follows, *viz.* 78° 13′ 32″
34
35
32
} Mean 78° 13′ 33″.

In a former article it has been shown, that Gringley is 76° 17′ 25″ south-east of the meridian of Clifton; therefore, 78° 13′ 33″ — 76° 17′ 25″ = 1° 56′ 8″, is the bearing of Laughton Spire from that meridian. The instrument, being otherwise adjusted for observation, was then brought into the plane of it, by setting off 1° 56′ 8″ on the azimuth circle; the permanency of the line of collimation of the lateral telescope having been previously ascertained.

Observations made at Clifton, to determine the Zenith Distance of β Draconis.

Point on the Limb, 1° 0′ South.

Day of the month.	Face of the arch, E. or W	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
July 20	W	12 1,04	12 14,8	1 0 0 13,76	1 0 13,78	28,8	58,0	56,0
22	W	7 53,33	13 12,0	17,67	15,52	28,7	54,0	54,5
26	E	13 27,55	13 6,8	20,75	20,78	28,8	64,2	64,3
28	W	9 21,94	9 32,3	10,36	10,38	28,8	59,5	58,5
29	E	9 3,13	8 44,1	18,03	18,06	28,8	56,5	57,5
31	W	9 34,59	9 44,1	9,51	9,52	29,0	57,2	56,5
Aug. 1	E	8 36,00	8 18,5	17,50	17,53	29,2	59,5	57,2
3	W	8 57,87	9 8,9	10,03	10,05	29,16	68,0	64,5
5	E	8 11,26	7 53,8	16,46	16,48	29,0	71,5	73,2
7	W	8 51,74	9 1,6	8,86	8,87	28,9	67,2	66,1
8	E	8 14,84	7 57,9	15,94	15,96	28,9	65,1	65,1
12	E	11 7,98	10 50,6	16,38	16,41	29,15	58,1	58,0
13	W	8 22,00	8 30,4	8,40	8,41	29,3	61,2	61,1
17	E	8 30,33	8 15,8	14,53	14,55	29,1	70,5	71,0
18	W	8 46,62	8 54,7	8,08	8,09	28,8	70,1	70,3

Observed Zenith Distance of γ Draconis.

Point on the Limb, 1° 55′ South.

Day of the month.	Face of the arch, E. or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Thermometer. Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
July 20	W	11 49,24	13 12,8	1 55 1 22,56	1 56 21,69	28,9	56,5	55,0
21	E	7 23,81	5 53,7	29,11	28,26	28,5	53,0	52,2
22	W	7 54,31	9 17,1	21,79	20,92	28,7	54,5	54,5
23	E	3 46,15	2 18,9	27,25	26,39	29,0	56,1	56,1
26	W	9 8,47	10 29,5	21,03	20,16	28,8	64,0	64,0
28	E	9 35,56	8 9,6	25,96	25,11	28,8	56,2	57,3
29	W	8 44,41	10 4,5	19,09	19,03	29,0	56,5	56,5
Aug. 1	W	8 41,22	10 3,0	20,78	19,91	29,2	59,5	57,0
3	E	9 7,59	7 40,3	26,29	25,43	29,1	68,0	64,5
5	E	7 50,50	6 25,0	25,50	24,64	29,0	73,0	71,0
7	W	9 7,55	10 24,6	17,05	16,18	28,9	64,2	65,2
12	E	11 7,56	9 42,7	23,86	23,00	29,1	57,5	57,5
13	W	8 12,48	9 29,4	16,92	16,04	29,3	63,0	61,2
17	E	8 10,32	6 46,0	23,32	22,46	29,0	69,5	70,5
18	W	8 32,97	9 48,5	15,53	14,65	28,8	70,0	70,1

Observed Zenith Distance of 45 d Draconis.

Point on the Limb, 3° 25′ North.

July 22	W	7 35,91	6 10,5	3 25 1 25,41	3 25 24,56	28,7	54,0	53,0
26	W	8 36,67	7 11,1	25,57	24,71	28,8	64,6	63,5
29	W	8 53,36	7 26,6	26,86	26,02	28,8	56,5	56,5
31	E	13 50,53	14 51,0	20,47	19,60	29,0	55,0	55,2
Aug. 7	W	8 47,50	7 18,6	28,90	28,04	28,9	65,0	64,0
12	E	11 9,60	12 31,0	21,40	20,53	29,2	55,5	55,5
13	W	8 10,99	6 38,9	31,09	30,24	29,3	60,1	59,1
17	E	8 14,53	9 38,9	24,37	23,51	29,0	71,0	69,5
18	W	8 15,03	6 41,3	32,73	31,88	28,8	—	68,0

Observed Zenith Distance of 46 c Draconis.

Point on the Limb, 1° 55′ North.

Day of the month.	Face of the arch E. or W	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Below
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
July 20	W	12 7,00	8 55,8	1 50 3 10,20	1 53 7,51	28,9	55,5	55,5
22	W	7 28,12	9 21,4	1 55 1 52,28	8,53	28,7	54,0	53,1
28	E	9 29,68	7 31,3	57,38	3,43	28,8	57,2	55,5
31	E	9 29,77	7 31,7	57,07	7,74	29,0	55,3	55,5
Aug. 3	E	8 55,40	7 0,6	54,80	6,01	29 1	04.0	63,5
5	E	7 11,47	5 15,8	54,67	5,14	29,0	73,5	71,5
7	W	6 37,64	10 26,6	47,96	12,86	28,9	65,2	64,2
12	E	11 3,15	9 9,0	53,15	7,66	29,2	55,5	59,1
13	W	8 6,41	9 52,5	46,09	14,73	29,3	60,0	59,0
17	E	8 25,75	6 32,3	52,45	8,36	29,0	71,2	69,5
18	W	8 20,25	10 6,3	45,05	15,78	28,8	71,0	68,0

Observed Zenith Distance of 51 Draconis.

Point on the Limb, 0° 20′ South.

July 28	E	9 31,75	7 50 7	0 20 1 40,05	0 29 39,21	28,8	55,0	55,0
31	E	9 29,90	7 48,5	40,04	39,56	29,0	55,0	55,5
Aug. 5	E	7 11,71	5 32,6	38,11	37,27	29,0	71,0	69,2
7	W	8 48,70	10 19,5	29,80	28,95	28,9	63,5	63,5
9	W	9 6,30	10 35,3	29,00	28,15	28,9	66,5	65,5
12	E	11 7,00	9 30,5	35,50	34,66	29,2	55,5	59,0
13	W	8 1,71	9 29,5	27,79	26,93	29,3	60,2	59,1
17	E	8 27,62	6 52,0	34,62	33,77	29,0	70,1	70,2
18	W	8 20,96	9 47,4	26,44	25,58	28,8	67,0	67,0

Observed Zenith Distance of μ Draconis.

Point on the Limb, 1° 15′ North.

July 20	W	11 51,87	10 9,3	1 15 1 42,57	1 16 41,73	28,9	58,0	56,0
28	W	9 11,90	7 26,9	44,00	43,17	28,8	58,2	58,5
29	E	9 11,32	10 51,0	39,63	38,84	28,8	56,5	57,5
30	W	9 55,53	8 10,0	45,53	44,70	28,8	59,0	57,5
Aug. 12	E	11 17,11	12 57,3	40,19	39,25	29,15	69,2	65,2
13	W	8 21,48	6 31,5	48,98	48,16	29,32	62,0	63,5

Observed Zenith Distances of 16 *Draconis.*

Point on the Limb, 0° 5′ *South.*

Day of the month.	Face of the arch, E. or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Thermometer. Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
July 29	E	9 26,41	6 31,7	2 53,71	2 53,99	28,8	59,7	59,5
30	W	9 38,07	12 26,0	46,93	45,20	28,8	62,5	60,1
Aug. 5	E	8 17,70	5 23,0	53,70	51,98	29,1	79,1	78,1

Observed Zenith Distances of 1 *x Cygni.*

Point on the Limb, 2° 25′ *North.*

July 20	W	13 45,26	15 42,5	0 25 1 56,24	0 26 55,43	28,9	56,5	55,0
22	W	9 12,66	11 10,3	56,64	55,83	28,7	54,0	54,0
26	W	9 42,42	11 39,1	55,68	54,87	28,8	64,5	63,5
28	E	9 29,47	7 27,2	2 2,27	27 0,47	28,8	55,2	55,2
29	W	9 3,65	11 7,4	3,75	1,95	28,9	56,9	55,0
30	W	9 43,53	11 37,3	1 52,77	26 51,95	28,7	57,0	55,0
31	E	9 30,77	7 28,5	2 2,27	27 0,47	29,0	55,0	55,0
Aug. 5	E	7 8,34	5 9,1	1 58,24	26 57,43	29,0	71,2	69,2
7	W	8 46,45	10 39,0	51,55	50,73	28,9	63,3	63,3
9	W	8 32,50	10 24,6	51,10	50,28	28,9	66,0	65 0
12	E	10 42,00	8 43,0	58,00	57,19	29,2	55,5	59,5
13	W	8 1,11	9 50,9	49,79	48,97	29,3	60,0	59,0
17	E	8 25,55	6 30,2	54,35	53,54	29,0	71,0	69,5
18	W	8 27,85	10 17,0	48,15	47,33	28,8	66,0	66,0

Observed Zenith Distances of 10 *i Cygni.*

Point on the Limb, 2° 10′ *South.*

July 20	W	13 51,27	12 27,2	2 10 1 24,07	2 8 36,79	28,9	56,5	55,0
28	E	9 22,60	10 42,5	19,90	40,97	28,8	57,3	55,5
29	W	9 8,23	7 38,5	28,73	32,12	28,8	56,7	56,5
30	W	9 31,50	8 4,0	27,50	33,36	28,7	55,5	57,5
31	E	9 19,20	10 39,5	20,30	40,57	29,0	55,0	55,2
Aug. 1	W	9 2,40	7 34,1	27,30	33,56	29,2	59,2	57,2
5	E	7 0,70	8 23,2	22,50	38,36	29,0	68,5	68,5
7	W	8 50,33	7 21,5	28,83	32,02	28,9	62,2	63,2
9	W	8 47,48	7 18,0	29,48	31,37	28,9	65,5	66,5
12	E	10 37,36	12 1,0	22,64	38,22	29,2	55,0	59,0
17	E	8 21,50	9 47,0	25,50	35,36	29,0	61,9	68,9
18	W	8 29,25	6 54,7	33,55	27,30	28,8	66,0	66,0

Observed Zenith Distance of γ Ursæ.

Point on the Limb, 1° 20′ North.

Day of the month.	Face of the arch. E. or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
Aug. 17	E	8 58,45	9 9,9	1 20 0 10,45	1 20 10,42	29,3	89,0	83,6

Observed Zenith Distances of η Ursæ.

Point on the Limb, 3° 5′ South.

July 23	W	9 1,35	13 5,0	3 5 4 3,65	3 9 0,05	29,0	62,5	62,5
26	W	9 26,00	13 30,9	4,90	1,30	28,9	78,0	78,2
Aug. 4	W	8 40,50	12 46,0	5,50	1,90	29,2	79,3	79,5
8	E	7 34,74	3 22,0	17,74	9,15	29,0	76,0	73,0
17	E	8 52,05	4 38,5	13,45	9,86	29,14	88,0	81,5

Observed Zenith Distances of ζ Ursæ.

Point on the Limb, 2° 30′ North.

July 29	E	9 8,82	9 21,5	2 30 0 12,68	2 30 12,70	28,8	69,0	65,5
Aug. 5	W	8 40,97	8 22,5	18,47	18,50	29,1	79,5	78,0
8	E	8 25,15	8 37,0	11,83	11,87	29,0	69,0	65,5
9	W	8 49,00	8 29,4	14,60	19,62	28,9	80,0	80,0
17	E	9 10,43	9 22,0	11,57	11,59	29,4	85,1	80,1

Observed Zenith Distances of 85 ι Herculis.

Point on the Limb, 7° 20′ South.

July 20	W	11 50,28	12 6,0	7 20 0 14,72	7 20 14,74	28,9	55,5	55,5
23	E	3 50,07	3 28,5	11,57	21,60	29,0	56,1	56,1
28	W	9 30,92	14 47,4	15 5 16,48	12,00	28,8	56,0	57,0
30	W	10 15,40	10 26,5	20 0 11,10	11,12	29,0	57,1	56,2
Aug. 1	W	9 6,18	9 17,0	10,82	10,84	29,2	59,5	57,2
5	E	8 2,52	7 42,0	19,52	19,75	29,0	73,0	71,0
7	W	9 17,54	9 29,0	11,46	11,48	28,9	67,2	66,1
17	E	8 15,52	7 56,0	18,52	18,55	29,0	70,5	71,2

Observed Zenith Distances of υ Herculis.

Point on the Limb, 6° 50′ South.

Day of the month.	Face of the arch, E. or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Thermometer. Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
July 21	E	8 11,5	6 16,6	5 50 1 53,7	6 51 52,89	28,5	55,5	54,5
29	E	9 14,1	7 17,0	56,1	55,29	28,8	60,7	61,5
30	W	7 57,8	9 48,8	46,0	47,17	28,8	62,5	60,0

Observed Zenith Distances of 52 Herculis.

Point on the Limb, 7° 5′ South.

July 28	W	8 58,72	11 15,5	7 5 2 15,78	7 7 14,00	28,8	58,5	58,5
29	E	9 11,35	6 47,0	23,35	21,58	28,8	59,7	59,5
30	W	10 1,29	12 16,0	14,71	12,93	28,8	61,0	59,0
Aug. 8	E	8 50,70	6 23,9	26,80	25,04	28,9	65,2	65,5

Observed Zenith Distances of 22 τ Herculis.

Point on the Limb, 6° 40′ South.

July 29	E	3 56,30	3 57,9	6 40 0 1,60	6 39 59,40	28,8	60,7	61,5
30	W	8 8,81	7 58,6	9,21	50,77	28,8	62,5	60,0
Aug. 1	W	8 5,20	7 53,1	11,10	48,88	29,2	67,0	67,0
7	W	10 1,73	9 50,5	10,23	49,75	28,9	71,0	69,0
12	W	10 16,30	10 4,0	12,50	47,48	29,2	65,2	63,3
13	E	8 12,30	8 16,8	4,50	55,49	29,3	67,3	66,5

Observed Zenith Distances of α Persei.

Point on the Limb, 4° 20′ South.

Aug. 8	W	9 7,66	7 45,7	4 20 1 20,96	4 18 39,91	28,9	66,5	63,0
10	W	8 38,84	7 18,0	20,84	40,03	28,9	70,2	71,0
13	E	10 27,76	11 45,6	17,84	43,03	29,3	57,0	54,0
18	E	8 26,58	9 43,5	16,92	43,95	29,0	60,2	60,2
19	W	8 11,42	6 47,5	22,92	37,94	28,8	60,5	60,3

Observed Zenith Distances of Capella.

Point on the Limb, 7° 40′ South.

Day of the month.	Face of the arch, E. or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Thermometer. Below.
		rev. div.	rev. div	° ′ rev. div.	° ′ ″	Inches.	°	°
Aug. 7	W	9 7,20	9 36,0	7 40 0 28,80	7 40 22,85	28,7	66,0	66,0
8	E	9 5,23	8 25,7	38,53	38,59	28,9	71,5	71,0
9	E	6 28,62	5 48,0	39,62	39 68	28,9	81,5	74,5
18	W	9 1,45	9 26,9	25,45	25,49	29,0	74,0	68,0
19	E	8 3,80	7 28,0	34,80	34,86	28,8	68,7	67,5

Operations at the new Station on Arbury Hill, near Daventry, with the Zenith Sector, in the Months of September and October, 1802.

In the Phil. Trans. for 1800, page 658, it will be seen, that the bearing of the Summer House on Bardon Hill, in the north of Leicestershire, from the meridian of Arbury Hill, is 7° 37′ 31″ NW; and, as this spot is only 2776 feet westward from the meridian of Dunnose itself, it follows, that 7° 37′ 31″ may be taken for the bearing of the above object from Arbury Hill. To avoid, however, the possibility of any error arising from adopting this supposition, the direction of the meridian was ascertained, (before the zenith sector was got up,) by a double azimuth of the pole star. From this it appeared, that the angular point of the roof of a house about seven miles distant, was within a few seconds of the true northern direction; and also, that Bardon Hill (the summer house) was 7° 37′ 35″ north-west. By observing these two objects, as the weather suited, the sector was afterwards got into the plane of the meridian.

Observations made on Arbury Hill, to determine the Zenith Distance of β Draconis.

Point on the Limb, 0° 15′ North.

Day of the month.	Face of the arch, E. or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Thermometer. Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
Sept. 8	W	9 48,90	10 54,7	0 15 1 5,80	0 13 55,09	28,2	51,0	54,0
18	E	9 37,98	8 26,5	11,48	49,40	28,8	70,5	72,5
19	W	9 17,78	10 23,0	5,22	55,67	28,8	71,5	76,5
20	E	9 16,33	8 6,5	9,83	51,06	28,8	68,2	69,0
22	E	9 26,17	8 16,0	10,17	50,71	28,8	79,3	75,3
23	W	8 21,00	9 25,0	4,00	56,89	28,9	76,5	76,5
24	E	9 7,68	7 57,0	9,68	51,21	28,9	71,0	70,5
25	W	9 29,13	10 34,0	4,87	56,02	29,1	74,5	75,5
26	E	9 4,27	7 51,8	11,47	49,41	29,0	64,5	66,5
28	W	10 43,25	11 48,7	5,45	55,45	29,0	65,5	65,5
29	E	9 27,65	8 17,3	10,35	50,53	29,1	79,0	77,5
30	W	9 25,82	10 30,7	4,88	56,04	29,0	64,0	69,5
Oct. 1	E	9 43,20	8 31,0	12,20	48,79	29,0	72,2	71,5
3	W	9 19,02	10 26,6	7,58	53,31	28,7	74,0	73,0

Observed Zenith Distances of γ Draconis.

Point on the Limb, 0° 40′ South.

Sept. 10	W	8 53,85	11 6,4	0 40 2 11,55	0 42 9,76	28,2	51,5	54,0
11	E	8 47,75	6 31,9	15,85	14,07	28,53	48,2	55,0
18	E	9 46,65	7 28,7	17,95	16,17	28,8	70,3	72,3
19	W	9 18,90	11 31,5	12,60	10,82	28,8	67,5	73,5
20	E	9 1,78	6 42,8	17,98	16,20	28,8	68,3	71,4
22	E	9 16,52	6 58,2	17,32	15,54	28,8	79,8	75,8
23	W	8 9,7	10 20,5	10,53	8,74	28,8	67,5	65,3
24	E	9 16 97	7 0,8	16,17	14,39	28,9	70,5	70,2
25	W	9 16,00	11 27,6	11,60	9,81	29,1	74,0	75,2
26	W	9 10.47	11 23,0	12,53	10,75	29,0	59,5	64,2
29	E	9 17,50	7 0,8	16,70	14,92	29,1	64,0	69,5
30	W	9 21,03	11 33,5	11,87	10,08	29,9	64,0	69,5
Oct. 1	E	9 34,95	7 15,5	19,45	17,87	28,9	72,5	71,9
2	E	9 25,33	7 7,0	18,33	16,57	28,8	71,0	75,0
3	W	8 54,30	11 7,1	11,80	10,01	28,6	74,0	73,0

Observed Zenith Distances of 45 *d Draconis.*

Point on the Limb, 4° 40′ *North.*

Day of the month.	Face of the arch, E. or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
Sept. 8	W	9 57,57	9 21,1	4 40 0 36,47	4 40 38,53	28,2	52,0	54,0
15	W	7 29,48	6 47,3	40,98	41,05	28,9	63,5	66,0
18	E	9 45,55	10 18,6	32,05	32,10	28,8	64,2	67,2
19	W	9 28,10	8 46,6	40,50	40,57	28,8	66,5	72,5
20	E	8 56,23	9 29,1	31,87	31,92	28,8	66,5	69,5
23	W	8 0,83	7 22,4	37,43	37,49	28,8	67,5	65,5
24	E	9 18,78	9 50,4	31,62	31,67	28,9	65,5	63,5
25	W	9 36,25	8 57,1	38,15	38,21	29,0	65,3	67,3
26	E	9 14,12	9 46,5	32,37	32,42	29,0	64,8	66,5
28	E	9 18,62	9 50,0	31,38	31,43	29,0	65,3	64,5
29	W	8 57,55	8 20,0	37,55	37,61	29,1	64,5	69,0
30	W	8 51,62	8 13,5	37,12	38,18	29,0	64,3	69,8
Oct. 1	E	9 25,05	14 58,7	33,65	29,20	28,9	72,0	71,5
2	E	9 18,35	9 50,6	32,35	32,40	28,8	72,5	75,5

Observed Zenith Distances of 46 *c Draconis.*

Point on the Limb, 3° 5′ *North.*

Sept. 7	E	9 3,63	11 19,23	3 5 2 15,40	3 7 13,62	28,5	63,0	64,5
10	E	9 3,73	11 19,4	15,67	13,89	28,2	51,0	54,0
15	W	7 30,08	5 6,5	23,58	21,85	28,9	63,5	66,0
16	W	10 22,70	7 55,9	24,80	23,04	29,0	61,5	65,5
18	E	9 29,12	11 47,0	17,88	16,11	28,8	64,0	67,0
19	W	9 40,57	7 16,3	24,27	22,51	28,8	66,5	72,0
20	E	8 34,27	10 52,3	18,03	16,26	28,8	66,0	69,0
21	W	9 55,90	7 29,0	26,90	25,14	28,8	66,5	69,5
22	E	8 2,67	11 20,4	17,73	15,95	28,8	79,2	75,3
23	W	9 20,01	6 45,0	24,10	22,34	28,8	67,5	65,0
24	E	9 3,97	11 22,3	18,33	16,56	28,8	65,5	63,0
25	W	9 42,55	7 19,2	23,35	21,58	29,0	65,5	67,3
26	E	9 9,10	11 27,0	17,90	16,12	29,0	64,5	66,5
28	E	9 17,52	11 35,0	17,48	15,70	29,0	65,5	64,5
29	W	9 13,00	7 48,4	23,60	21,83	29,0	64,5	69,0
30	W	9 4,20	6 38,8	24,40	22,64	29,1	64,5	69,5
Oct. 1	E	9 18,65	11 36,1	17,45	15,67	29,0	68,2	61,4
2	E	9 22,35	14 41,1	18,75	16,97	28,8	68,0	70,5

Observed Zenith Distances of 1 *ν Cygni.*

Point on the Limb, 0° 45′ *North.*

Day of the month.	Face of the arch, E or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
Sept. 7	E	8 12,72	10 25,2	0 45 2 12,48	0 47 10,69	28,2	51,0	54,0
8	W	6 54,92	4 36,0	18,92	17,15	28.2	51,5	54,5
15	W	8 52.42	6 31,5	20,92	19,15	28,9	62,5	65,3
16	W	10 31,57	8 9,0	22,57	20,80	28,9	61,0	65,0
18	E	8 21,80	10 38,0	16,20	14,42	28,8	64,3	67,5
19	W	9 37,03	7 14,5	22,53	20,77	28,8	66,5	72,0
20	E	8 24,05	15 43.6	40 7 19,55	13,27	28,8	65,0	67,0
22	E	8 50,82	11 9,0	45 2 17,18	15,40	28,8	66,3	66,5
23	W	8 56,10	6 33.5	22,60	20,83	28,8	67,5	65,3
24	E	8 32,52	10 48,5	15.98	14,20	28,9	59.3	63,5
25	W	9 44,57	7 23,5	21,07	19,30	29,0	66,5	67,0
26	E	9 20,58	11 36,0	15,42	13,64	29,0	64,5	66,5
28	E	9 31,90	11 47,7	15,80	14,02	29,0	60,5	62,5
29	W	9 58,00	7 35,0	23,00	21.23	29,0	64,5	68,0
30	W	9 48,10	7 24.9	23,20	21.43	29,0	62,0	65,5
Oct. 1	E	9 9,42	11 26,0	16,58	14,80	28,9	64,0	66,5
2	E	9 27,82	11 38,0	16,18	14,40	28,0	65,0	68,0

Observed Zenith Distances of 51 *Draconis.*

Point on the Limb, 0° 50′ *North.*

Sept. 7	E	8 13,88	5 43,5	0 55 2 29,38	0 52 32,37	28,2	51,5	54,5
8	W	6 41,63	4 1,5	0 50 2 49.13	38.39	28.2	51,0	54,0
10	E	9 16,00	11 53,7	37,70	35.96	28,2	51,0	54,0
16	W	10 39.00	7 55,5	42,50	40,77	29,0	61,7	65,5
18	E	8 42,00	11 19,7	36,70	34.96	28,8	64,0	67,2
19	W	9 56.73	7 13,6	43,13	41,42	28,8	66,5	72,0
20	E	8 26,10	11 13,0	35,90	34,15	28,8	66,5	69,5
22	E	8 54,28	11 31,2	35,92	34.17	28,8	68,5	63,0
23	W	9 4.53	6 21.9	41,63	39.89	28,8	67,5	65,5
25	W	9 34 53	6 51,5	42,03	40,30	29,0	67,0	67,0
26	E	9 24.17	12 1,4	36,23	34.49	29,0	59,5	64,5
28	E	9 30,17	12 7,3	36,13	34,39	29,0	66,0	64,0
29	W	9 17.85	6 53,9	40,95	39,21	29,0	65,5	69,5
30	W	9 35.83	6 51,0	43,83	42,10	29,0	64,0	70,3
Oct. 1	E	9 11 55	11 49,0	37,45	35,71	29,0	68,0	68,0
2	E	9 24,62	11 2,4	36,78	35,04	28,8	68,0	70,5

Observed Zenith Distance of 10 ι Cygni.

Point on the Limb, 0° 55′ South.

Day of the month.	Face of the arch, E. or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
Sept. 18	E	8 19,17	8 53,6	0 55 0 34,43	0 54 25,51	28,8	64,5	67,5
19	W	9 37,65	9 2,2	35,45	20,49	28,8	66,5	72,0
20	E	8 31,87	9 7,5	34,63	25,31	28,8	65,0	67,0
21	W	10 16,65	9 35,3	40,35	19,58	28,8	65,2	67,2
22	E	8 51,59	9 28,2	35,61	24,33	28,8	66,0	66,0
23	W	8 49,25	8 10,5	38,75	21,19	28,8	65,5	65,5
24	E	8 22,08	8 56,0	33,91	26,02	28,8	59,0	63,0
25	W	9 45,92	9 7,0	38,92	21,02	29,0	66,5	67,0
26	E	9 11,63	9 46,4	34,77	25,17	29,0	59,0	64,0
27	W	8 57,40	8 13,4	44,00	19,93	29,0	52,0	55,5
28	E	8 54,83	9 31,1	35,27	24,67	29,0	60,0	62,0
29	W	9 52,90	9 12,0	40,90	19,03	29,0	64,5	68,0
30	W	9 53,38	9 11,3	42,08	17,85	29,0	62,0	65,0
Oct. 1	E	9 10,95	9 47,0	36,05	23,89	28,9	64,0	66,5
2	E	9 23,18	10 0,3	36,12	23,82	28,8	68,5	65,5

Observed Zenith Distances of γ Ursæ.

Point on the Limb, 2° 35′ North.

Sept. 18	E	9 32,47	8 34,9	2 35 0 56,57	2 34 3,33	28,8	77,5	76,5
23	W	8 20,07	9 20,1	2 35 0 57,03	2,87	28,9	80,0	76,0
26	W	9 22,70	10 18,5	54,80	5,10	29,1	80,5	75,0
Oct. 3	E	9 10,45	8 2,5	1 7,95	33 52,94	28,7	72,8	78,5

Observed Zenith Distances of η Ursæ.

Point on the Limb, 1° 55′ South.

Sept. 10	W	8 16 58	8 24 4	1 55 0 7,82	1 55 7,83	28,1	63,0	64,5
20	E	9 26.02	9 13,9	12,12	12,14	28,8	84,5	80,5
23	W	8 4.60	8 14,1	9,50	9,51	28,9	84,0	82,5
24	E	8 50,25	8 34,5	15,75	15 77	28,9	79,0	75,0
25	W	9 21,40	9 33,5	12 10	12,12	29,0	82 8	80,5
26	E	8 54,63	8 36,6	18 03	18,00	29,1	80,0	77,0
28	E	10 5,25	9 47,7	16 55	16,57	29,1	78,5	72,5
30	W	10 6,12	10 15,0	8,88	8 89	29,1	84,0	76,0
Oct, 3	E	9 27,63	9 9,2	18,43	18,46	29,0	80,0	76,2

Observed Zenith Distances of ζ Ursæ.

Point on the Limb, 3° 45′ North.

Day of the month.	Face of the arch, E. or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Thermometer. Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
Sept. 24	E	8 40,70	7 44,4	3 45 0 55,60	3 44 4,31	28,9	79,5	75,5
26	W	9 1,95	9 53,5	51,55	8,36	29,1	80,0	77,5
30	E	9 50,72	8 50,0	1 0,72	0,18	29,0	84,0	76,0
Oct. 3	E	7 3,00	6 1,9	1 1,10	43 59,80	28,7	80,5	75,5

Observed Zenith Distances of 22 τ Herculis.

Point on the Limb, 5° 15′ South.

Sept. 18	E	9 50,42	8 52,5	5 25 0 56,92	5 25 57,01	28,8	72,5	74,5
Oct. 3	W	9 33,10	10 24,5	50,40	50,48	28,6	76,5	76,0

Observed Zenith Distances of α Persei.

Point on the Limb, 3° 5′ South.

Sept. 8	E	7 35,23	8 0,6	3 5 0 23,37	3 4 36,59	28,8	41,0	44,0
12	E	8 29,27	8 52,5	23,23	36,73	28,8	41,5	44,5
16	W	9 17,50	8 47,9	28,00	31,35	28,9	55,7	57,5
18	W	9 53,52	9 25,3	28,22	31,73	28,8	57,2	58,5
19	E	7 52,87	8 11,0	23,13	36,83	28,8	53,5	58,0
22	E	7 44,73	8 9,3	23,57	36,39	28,8	58,0	62,0
23	W	8 58,00	8 27,4	30,60	29,35	28,7	60,0	60,0
25	E	8 58,42	9 23,7	24,28	35,67	29,0	49,5	53,5
26	W	9 49,10	9 19,8	29,30	30,65	29,1	55,5	54,3

Observed Zenith Distances of Capella.

Point on the Limb, 7° 40′ South.

Day of the month.	Face of the arch, E. or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer.	Thermometer. Above.	Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°	°
Sept. 11	E	9 47,77	8 15,9	6 25 1 33,87	6 26 33,02	28,8	46,5	50,5
12	E	8 45,17	7 12,1	33,07	32,22	28,7	38,5	43,5
14	W	7 41,57	9 9,1	26,53	25,67	28,8	53,5	50,5
16	W	9 51,50	10 20,3	27,80	26,94	28,9	54,5	56,5
18	E	9 24,77	7 48,8	34,97	34,12	28,9	55,0	58,0
19	W	8 10,88	9 38,0	27,52	26,66	28,9	50,0	57,5
20	E	8 48,20	7 15,2	33,00	32,15	28,8	57,2	59,1
21	W	8 16,97	9 45,5	28,53	27,67	28,8	54,0	56,5
22	E	9 6,93	7 34,0	31,93	31,08	28,8	58,0	62,0
23	W	8 48,50	10 16,2	26,70	25,84	28,7	60,5	58,5
25	E	8 53,40	7 20,0	33,30	32,45	29,0	48,5	48,5
26	W	9 49,52	11 18,6	28,08	27,22	29,1	55,0	56,5

Operations at the Royal Observatory with the Zenith Sector. April, 1802.

Observed Zenith Distances of β Draconis.

Point on the Limb, 0° 55′ North.

April 16	W	9 57,80	6 44,2	0 55 3 13,60	0 58 10,92	29,9	40,0	40,0
23	E	8 35,49	11 40,9	5,41	2,71	30,1	38,0	38,0
25	W	10 7,84	6 53,0	13,84	11,16	29,8	44,0	44,0
26	W	9 24,63	6 11,5	13,13	10,45	29,5	42,0	42,0

Observed Zenith Distances of γ Draconis.

Point on the Limb, 0° 0′ North.

April 16	W	10 21,73	8 18,5	0 0 2 3,23	0 2 1,43	29,9	45,0
19	W	9 9,40	7 4,1	5,30	3,50	31,1	53
22	E	8 14,48	10 9,5	1 54,02	1 53,21	29,9	55
23	E	9 21,79	10 18,5	55,71	54,90	30,1	38
25	W	9 39,52	7 34,4	2 5,12	2 3,32	29	44

Observed Zenith Distances of 45 *Draconis.*

Point on the Limb, 5° 20′ *North.*

Day of the month.	Face of the arch, E. or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance reduced.	Barometer. Above.	Thermometer. Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	°
April 19	W	9 38,57	4 46,5	5 20 4 51,07	5 24 47,48	31,1	53
23	E	8 21,37	13 6,0	43,63	40,01	30,1	38
25	W	9 47,20	4 54,5	51,70	48,19	29,8	40

Observed Zenith Distance of 46 *c Draconis.*

Point on the Limb, 3° 50′ *North.*

April 15	W	9 15,70	7 41,9	3 50 1 32,80	3 51 31,95	29,8	44

Observed Zenith Distance of 51 *Draconis.*

Point on the Limb, 1° 36′ *North.*

April 19	W	9 48,80	8 55,7	1 35 0 52,10	1 35 52,19	31,1	53
23	E	8 43,56	10 27,8	43,34	43,31	30,1	38
25	W	8 54,53	7 46,0	49,83	49,91	29,8	44

Observed Zenith Distance of 1 *κ Cygni.*

Point on the Limb, 1° 30′ *North.*

April 23	E	9 20,36	10 42,8	1 30 1 22,44	1 31 21,53	30,1	38
25	W	8 29,76	6 58,6	30,16	29,31	29,5	51

Observed Zenith Distance of 10 *ι Cygni.*

Point on the Limb, 0° 10′ *South.*

April 19	W	11 32,42	11 42,6	0 10 0 10,18	0 10 10,19		
23	E	9 36,12		18,42	18,45		

Observed Zenith Distance of γ Ursæ.

Point on the Limb, 3° 15′ North.

Day of the month.	Face of the arch, E. or W.	Plumb-line.	Observation of the star.	Zenith distance in revolutions and parts.	Zenith distance rectified.	Barometer. Above.	Thermometer. Below.
		rev. div.	rev. div.	° ′ rev. div.	° ′ ″	Inches.	•
April 20	E	8 44,30	12 42,7	3 15 3 58,40	3 18 55,79	29,9	50
22	E	10 36,00	14 36,0	4 0,00	56,39	29,9	50
23	E	4 28,25	8 29,5	0,75	57,14	30,1	48
24	W	9 36,90	5 25,1	11,80	19 8,21	29,8	47

Observed Zenith Distance of η Ursæ.

Point on the Limb, 1° 10′ South.

April 16	W	10 13,90	10 40,7	1 10 0 26,80	1 10 26,84	29,9	45
23	E	3 37,50	3 4,6	32,40	32,45	30,1	38

Observed Zenith Distance of 85 ι Herculis.

Point on the Limb, 5° 20′ South.

April 16	W	11 1,59	11 47,9	5 20 0 46,31	5 20 46,39	29,0	40
19	W	9 40,30	10 30,5	39,26	39,26	31,5	53
23	E	9 21,16	9 23,5	56,66	56,75	30,1	38

Table showing the Runs of the Micrometer-screw over every 5′ in the first Degree on each Side of Zero.

Right Hand Arc.

At	°	′	R.	D.		R.	D.
	0	0	8	55,43	} —	5	4,45
	0	5	14	0,88	}		
	0	5	9	32,55	} —	5	4,55
	0	10	14	37,10	}		
	0	10	9	40,03	} —	5	4,34
	0	15	14	44,37	}		
	0	15	9	19,13	} —	5	4,45
	0	20	14	23,58	}		
	0	20	9	54,07	} —	5	4,40
	0	25	14	58,47	}		
	0	25	9	39,23	} —	5	4,41
	0	30	14	43,64	}		
	0	30	9	25,77	} —	5	4,44
	0	35	14	30,21	}		
	0	35	9	58,53	} —	5	4,54
	0	40	15	4,07	}		
	0	40	9	0,53	} —	5	4,54
	0	45	14	5,07	}		
	0	45	9	12,47	} —	5	4,55
	0	50	14	17,02	}		
	0	50	9	43,07	} —	5	4,43
	0	55	14	47,50	}		
	0	55	8	41,27	} —	5	4,50
	1	0	13	45,77	}		

Left Hand Arc.

At	°	′	R.	D.		R.	D.
	0	0	9	16,31	} —	5	4,54
	0	5	4	11,77	}		
	0	5	9	8,73	} —	5	4,56
	0	10	4	4,17	}		
	0	10	8	53,67	} —	5	4,50
	0	15	3	49,17	}		
	0	15	9	16,13	} —	5	4,44
	0	20	4	11,69	}		
	0	20	9	17,50	} —	5	4,53
	0	25	4	12,97	}		
	0	25	10	4,30	} —	5	4,50
	0	30	4	58,80	}		
	0	30	8	52,0	} —	5	4,47
	0	35	3	47,53	}		
	0	35	9	7,83	} —	5	4,53
	0	40	4	3,30	}		
	0	40	9	3,31	} —	5	4,41
	0	45	3	57,90	}		
	0	45	9	12,63	} —	5	4,40
	0	50	4	8,23	}		
	0	50	9	4,50	} —	5	4,47
	0	55	4	0,03	}		
	0	55	8	35,0	} —	5	4,57
	1	0	3	30,43	}		

Table for converting the Divisions shewn on the Micrometer Head into Seconds; the Space subtended by 5′ on the Limb being found = 5 Revolutions 45 Divisions, as deduced from the Measurement of the Total Arches.

R.	D.	″
0	1	1,002
0	2	2,003
0	3	3,005
0	4	4,007
0	5	5,008
0	6	6,010
0	7	7,012
0	8	8,013
0	9	9,015
0	10	10,016
0	11	11,018
0	12	12,020
0	13	13,022
0	14	14,023
0	15	15,025
0	16	16,027
0	17	17,028
0	18	18,030
0	19	19,032
0	20	20,033
0	21	21,035
0	22	22,037
0	23	23,038
0	24	24,040
0	25	25,042
0	26	26,043
0	27	27,045
0	28	28,047
0	29	29,043
0	30	30,050
0	31	31,052
0	32	32,053
0	33	33,055
0	34	34,057
0	35	35,058
0	36	36,060
0	37	37,062
0	38	38,063
0	39	39,065
0	40	40,067
0	41	41,068
0	42	42,170
0	43	43,072
0	44	44,073
0	45	45,075
0	46	46,077
0	47	47,078
0	48	48,080
0	49	49,082
0	50	50,083
0	51	51,085
0	52	52,087
0	53	53,088
0	54	54,090
0	55	55,092
0	56	56,093
0	57	57,095
0	58	58,097

Table for supplying the necessary Correction to the observed Zenith Distance of a Star, on account of the Expansion or Contraction of the sectorial Tube by 1° *of Heat.*

Zenith distance observed	Correction for 1° of heat.	Zenith distance observed.	Correction for 1° of heat.
° ′	″	° ′	″
1 —	0,018	4 30 —	0,084
1 30 —	0,028	5 —	0,093
2 —	0,037	5 30 —	0,102
2 30 —	0,046	6 —	0,111
3 —	0,056	6 30 —	0,121
3 30 —	0,065	7 —	0,130
4 —	0,074	7 30 —	0,129

In using the above Table, the corrections are to be taken as negative, if the upper thermometer denotes the air to be hotter towards the top of the observatory than round the limb of the sector; and positive, if the reverse.

Reduction of the several Observations contained in the preceding Article, from the respective Days on which they were made, to the first of January, 1802; the Equations being those for Aberration, Nutation, semi-annual solar Equation, Precession, and Refraction; with the Zenith Distances of the several Stars deduced therefrom.

Reduction of the Observations made at Dunnose.

β Draconis, N.

Face of limb, West.		Face of limb, East.			
May 11—1° 50′	7″,65	May 13—1° 50′	0″,23	Zenith dist. 1° 50′ 3″,46	
14	7,0	16	1,10	+1,83	Mean refraction.
June 5	6,11	June 8	0,12	−0,05	Temperature.
				+0,00	Expansion of axis.
11	6,99	13	0,55	Mean zen. dist. 1 50 5,24.	
14	5,87	16	0,01	Line of collimation 3,42.	
17	6,32	18	49 58,59		
20	7,43	21	0,68		
Mean 1 50	6,88	Mean 1 50	0,04		

γ Draconis, N.

May 11—0° 54′	0″,34	May 10—0° 53′	51″,66	Zenith dist. 0° 53′ 55″,75	
14	0,12	13	52,31	+ 0,91	Refraction.
June 11	53 59,45	16	51,54	− 0,02	Temperature.
				− 0,01	Expansion of axis.
14	59,14	June 13	51,53	Mean zen. dist. 0 53 56,63.	
17	59,44	17	53,58	Line of collimation 3,64.	
20	57,83	18	51,11		
		21	53,07		
Mean 0 53	59,39	Mean 0 53	52,11		

45 d Draconis, N.

June 14—6° 16′	45″,24	June 13—6° 16′	36″,66	Zenith dist. 6° 16′ 41″,70	
18	47,41	16	37,91	+ 6,29	Refraction.
21	45,99	20	37,47	− 0,21	Temperature.
				− 0,12	Expansion of axis.
Mean 6 16	46,21	Mean 6 16	37,29	Mean zen. dist. 6 16 47,66.	
				Line of collimation 4,46.	

46 c Draconis, N.

June 14—4° 43′	29″,43	June 13—4° 43′	20″,76	Zenith dist. 4° 43′ 24″,42+4″,71 (refr. &c.) = 4° 43′ 28″,93.	
18	26,06	16	19,99	Line of collimation 3,41.	
21	28,09	28	22,18		
Mean 4 43	27,86	Mean 4 43	20,98		

51 *Draconis, N.*

Face of limb, West.		Face of limb, East.		
June 14—2° 28′	45″,62	June 13—2° 28′	38″,26	Zenith dist. 2° 28′ 41″,71 + 2″,34 (refr. &c.) = 2° 28′ 44″,05.
18	44,85	10	37,67	Line of collimation 3,40.
21	44,85	20	39,01	
Mean 2 28	45,11	Mean 2 28	38,31	

μ *Draconis, N.*

May 11—4° 7′	1″,57	May 13—4° 6′	51″,29	Zenith dist. 4° 6′ 55″,30 + 4″, (refr. &c.) = 4° 6′ 59″,30.
14 6	57,63	June 8	51,58	Line of collimation 3,68.
June 14	59,13	13	51,00	
17	58,18	16	51,12	
20	58,43	18	52,20	
		21	52,57	
Mean 4 6	58,99	Mean 4 6	51,62	

16 *Draconis, N.*

May 11—2° 42′	34″,99	June 13—2° 42′	26″,55	Zenith dist. 2° 42′ 30″,63 + 2″,63 (refr. &c.) = 2° 42′ 33″,26.
14	34,17	16	27,73	Line of collimation 3,58.
16	33,27	18	26,85	
June 11	34,25			
14	34,26			
20	34,31			
Mean 2 42	34,21	Mean 2 42	27,04	

1 *κ Cygni, N.*

June 14—2° 23′	26″,44	June 13—2° 23′	16″,46	Zenith dist. 2° 23′ 20″,58 + 2″,28 (refr. &c.) = 2° 23′ 22″,86.
18	23,20	16	16,54	Line of collimation 3,80.
21	20,51	20	17,31	
Mean 2 23	24,38	Mean 2 23	16,77	

10 *ι Cygni, N.*

June 14—0° 41′	43″,52	June 13—0° 41′	35″,84	Zenith dist. 0° 41′ 40″,08 + 0″,68 (refr. &c.) = 0° 41′ 40″,68
18	43,53	16	36,42	Line of collimation 3,15.
21	42,69	20	38,54	
Mean 0 41	43,24	Mean 0 41	36,93	

γ *Ursæ, N.*

May 11—4° 10′	33″,47	May 9—4° 10′	28″,18	Zenith dist 4° 10′ 32″,46 + 3″,77 (refr. &c.) = 4° 10′ 36″,23.
15	36,73	10	28,58	Line of collimation 3,02.
June 5	36,05	13	29,82	
13	35,75	14	29,02	
14	34,80	17	30,01	
		20	29,42	
		June 8	30,24	
		16	30,24	
Mean 4 10	35,48	Mean 4 10	29,44	

η Ursæ, S.

Face of limb, West.		Face of limb, East.		
May 14—0° 18′	38″,84	May 10—0° 18′	44″,08	Zenith dist. 0° 18′ 42″,61 + 0″,32 (refr. &c.) = 0° 18′ 42″,93.
16	40,16	13	45,86	Line of collimation 3,06.
June 5	39,64	15	46,11	
11	37,13	17	45,01	
13	38,62	June 8	47,04	
16	42,06	12	46,57	
18	39,89	14	45,21	
		20	46,18	
		21	43,78	
Mean 0 18	39,48	Mean 0 18	45,54	

ζ Ursæ, N.

May 11—5° 20′	34″,10	May 13—5° 20′	26″,41	Zenith dist. 5° 20′ 30,″53 + 5″,13 (refr. &c.) = 5° 20′ 35″,66.
June 5	34,15	17	28,46	Line of collimation 3,76.
11	34,42	June 8	25,28	
18	34,57	14	26,96	
		17	26,38	
		20	27,14	
Mean 5 20	34,30	Mean 5 20	26,77	

85 i Herculis, S.

May 14—4° 29′	54″,76	May 10—4° 30′	0″,16	Zenith dist. 4° 29′ 57″,48 + 4″,47 (refr. &c.) = 4° 30′ 1″,95.
June 14	53,20	13	1,39	Line of collimation 3,46.
		16	1,18	
Mean 4 29	53,98	Mean 4 30	0,91	

υ Herculis, S.

May 14—4° 1′	25″,29	May 13—4° 1′	33″,50	Zenith dist. 4° 1′ 29″,55 + 3″,69 (refr. &c.) = 4° 1′ 33″,24.
16	26,46	June 13	32,52	Line of collimation 3,35.
June 5	26,51	16	32,56	
14	26,51	18	32,56	
		20	33,46	
Mean 4 1	26,19	Mean 4 1	32,90	

52 Herculis, S.

May 14—4° 16′	53″,72	May 13—4° 17′	0″,15	Zenith dist. 4° 16′ 57″,08 + 4″,20 (refr. &c.) = 4° 17 1″,28.
June 11	53,23	16	0,34	Line of collimation 3,76.
14	52,63	June 8	0,60	
17	54,90	13	0,63	
20	54,02	16	0,60	
		21	0,51	
Mean 4 16	53,70	Mean 4 17	0,47	

22 τ *Herculis.*

Face of limb, West.		Face of limb, East.		
May 11	3° 49′ 30″,31	May 10	3° 49′ 38″,10	Zenith dist. 3° 49′ 33″,32 + 3″,78 (refr. &c.) = 3° 49′ 37″,10.
14	29,26	13	37,23	Line of collimation 3,16.
16	30,63	June 8	35,04	
June 5	29,92	13	35,88	
11	29,43	18	35,86	
14	30,09	21	36,83	
17	29,86			
20	31,58			
Mean	3 49 30,16	Mean	3 49 36,49	

Capella, S.

May 12	4° 50′ 55″,46	May 11	4° 50′ 2,″79	Zenith dist. 4° 59′ 58″,81 + 4″,07 (refr. &c.) = 4° 50′ 2″,88.
15	54,02	13	1,47	Line of collimation 3,31.
June 8	54,87	June 11	2,0	
15	55,87	16	2,26	
21	56,91			
22	55,24			
Mean	4 50 55,49	Mean	4° 50 2,13	

Reduction of the Observations made at Clifton, (the northern Extremity of the meridional Arc,) and the Zenith Distances of the several Stars deduced therefrom.

β *Draconis, S.*

July 20	1° 0′ 13″,82	July 26	1° 0′ 22″,41	Zenith dist. 1° 0′ 16″,89 + 0″,95 (refr. &c.) = 1° 0′ 17″,84.
22	13,15	29	20,26	Line of collimation 3,78.
28	12,38	Aug. 1	20,39	
31	12,15	5	20,16	
Aug. 3	13,29	8	20,15	
7	12,87	12	21,25	
3	13,42	17	20,11	
18	13,80			
Mean	1 0 13,11	Mean	1 0 20,68	

γ *Draconis, S.*

July 20	1° 56′ 21″,63	1° 56′ 28″,50	Zenith dist. 1° 56′ 24″,86 + 1″,78 (refr. &c.) = 1° 56′ 26″,64.
22	21,47	27,14	Line of collimation 3,30.
26	21,72	27,15	
29	21,67	28,86	
Aug. 1	22,90	28,54	
11	20,45	28,28	
13	21,55	28,66	
18	21,03		
Mean	1 56 21,56	Mean 1 56	28,16

45 *d Draconis, N.*

Face of limb, West.		Face of limb, East		
July 22	3° 26′ 23″,96	July 31	3° 26′ 16″,41	Zenith dist. 3° 26′ 19″,63+3″,29 (refr. &c.)=3° 26′ 22″,92.
26	22,92	12	15,23	Line of collimation 3,72.
29	23,35	17	16,09	
Aug. 7	23,0			
13	23,7			
18	23,26			
Mean	3 26 23,36	Mean	3 26 15,91	

46 *c Draconis, N.*

July 20	1° 53′ 7″,60	July 28	1° 53′ 1″,11	Zenith dist. 1° 53′ 4″,44+1″,80 (refr. &c.)=1° 53′ 6″,24.
22	8,01	31	52 59,97	Line of collimation 3,47.
Aug. 7	7,77	Aug. 3	53 1,99	
13	8,20	5	0,59	
18	8,04	12	1,34	
		17	0,84	
Mean	1 53 7,92	Mean	1 53 0,97	

51 *Draconis, S.*

Aug. 7	0° 21′ 33″,26	July 28	0° 21′ 41″,62	Zenith dist. 0° 21′ 37″,78+0″,34 (refr. &c.)=0° 21′ 38″,12.
9	33,99	31	42,87	Line of collimation 4,15.
13	33,83	Aug. 5	42,16	
18	33,45	12	41,30	
		17	41,68	
Mean	0 21 33,63	Mean	0 21 41,93	

μ Draconis, N.

July 20	1° 16′ 39″,87	July 29	1° 16′ 34″,53	Zenith dist. 1° 16′ 36″,97+1″,23 (refr. &c.)=1° 16′ 38″,20.
28	38,98		32,92	Line of collimation 3,25.
30	40,32			
Aug. 13	41,73			
Mean	1 16 40,22	Mean	1 16 33,72	

16 *Draconis, S.*

July 30	0° 7′ 47″,75	July 29	0° 7′ 54″,09	Zenith dist. 0° 7′ 51″,15+0″,10 (refr. &c.)=0° 7′ 51″,25.
		Aug. 5	0 55,04	Line of collimation 3,40.
		Mean	0 7 54,56	

1 *κ Cygni, S.*

July 20	0° 26′ 55″,72	July 28	0° 27′ 3″,20	Zenith dist. 0° 26′ 59″,91+0″,41 (refr. &c.)=0° 27′ 0″,32.
22	56,66	29	4,99	Line of collimation 3,68.
26	56,97	31	4,36	
29	56,35	Aug. 5	2,56	
30	55,28	12	4,29	
Aug. 7	56,45	17	2,20	
9	56,55			
13	56,36			
18	55,79			
Mean	0 26 56,23	Mean	0 27 3,60	

10 *i Cygni, S.*

Face of limb, West.		Face of limb, East.		
July 20—2°	8′ 36″,86	July 28—2°	8′ 42″,47	Zenith dist. 2° 8′ 40″,23+1,″99 (refr. &c.)=2° 8′ 42,″22.
29	35,01	31	44,05	Line of collimation 3,55.
30	36,42	Aug. 5	43,54	
Aug. 1	37,37	12	45,24	
7	37,62	17	43,76	
9	37,56			
18	35,96			
Mean 2	8 36,68	Mean 2	8 43,79	

γ *Ursæ, N.*

Aug. 17—1° 20′ 8,″84.

ζ *Ursæ, N.*

Aug. 5—2°	30′ 10″,72	July 29—2°	30′ 4,″59	Zenith dist. 2° 30′ 8″,18+2″,19 (refr. &c.)=2° 30′ 10″,37.
9	12,38	Aug. 8	4,47	Line of collimation 3,37.
		17	5,39	
Mean 2	30 11,55	Mean 2	30 4,81	

η *Ursæ, S.*

July 23—3°	8′ 59,″78	Aug. 8—3°	9′ 8″,03	Zenith dist. 3° 9′ 4″,26+2″,72 (refr. &c.)=3° 9′ 6″,98.
26	9 0,93	17	7,85	Line of collimation 3,67.
Aug. 4	9 1,07			
Mean 3	9 0,59	Mean 3	9 7,94	

85 *i Herculis, S.*

July 20—7°	20′ 14″,13	July 23—7°	20′ 21″,69	Zenith dist. 7° 20′ 18″,08+6″,90 (refr. &c.)=7° 20′ 24″,98.
28	13,19	5	22,57	Line of collimation 4,52.
31	12,93	17	23,59	
Aug. 1	12,86			
7	14,71			
Mean 7	20 13,56	Mean 7	20 22,61	

υ *Herculis, S.*

July 30—6°	51′ 46″,31	July 21—6°	51′ 52″,89	Zenith dist. 6° 51′ 50″,45+6″,35 (refr. &c.)=6° 51′ 56″,80.
		29	56,32	Line of collimation 4,14.
		Mean 6	51 54,60	

52 *Herculis, S.*

July 28—7°	7′ 15″,02	July 29—7°	7′ 22″,76	Zenith dist. 7° 7′ 18″,69+6″,76 (refr. &c.)=7° 7′ 25″,45.
30	14,21	Aug. 8	22,63	Line of collimation 4,04.
Mean 7	7 14,6	Mean 7	7 22,69	

22 *τ Herculis, S.*

July 30—6°	39′ 51″,84	July 29—6°	40′ 0″,32	Zenith dist. 6° 39′ 55″,11+6″,18 (refr. &c.)=6° 40′ 1″,29.
Aug. 4	50,64	Aug. 13	39 58,02	Line of collimation 4,16.
7	51,80			
12	49,96			
Mean 6	39 51,06	Mean 6	39 59,17	

α Persei, S.

Face of limb, West.	Face of limb, East.	
Aug. 8—4° 18′ 29″,44	Aug. 13—4° 18′ 33″,15	Zenith dist. 4° 18′ 31″,65+4″,37 (refr. &c.)=4° 18″ 36′,02.
29,78	18 34,76	Line of collimation 2,28.
28,87		
Mean 4 18 29,36	Mean 4 18 33,95	

Capella, S.

Aug. 7—7° 40′ 15″,60	Aug. 8—7° 40′ 25″,30	Zenith dist. 7° 40′ 19″,06+6″,60 (refr. &c.)=7° 40′ 25″,66.
18 11,94	9 26,46	Line of collimation 5,30.
	19 21,32	
Mean 7 40 13,76	Mean 7 40 24,36	

Reduction of the Observations made at Arbury Hill, (the intermediate Point on the meridional Arc,) and the Zenith Distances of the several Stars deduced therefrom.

β Draconis, N.

Sept. 8—0° 13′ 47″,67	Sept. 18—0° 13′ 41″,91	Zenith dist. 0° 13′ 45″,61+0″,21 (refr. &c.)=0° 13′ 45″,82.
19 48,20	20 43,61	Line of collimation 2,71.
23 49,55	22 43,32	
25 48,76	24 43,90	
28 48,38	26 42,24	
30 49,10	29 43,54	
Oct. 3 46,63	Oct. 1 41,94	
Mean 0 13 48,33	Mean 0 13 42,92	

γ Draconis, S.

Sept. 10—0° 42′ 18″,72	Sept. 11—0° 42′ 23″,08	Zenith dist. 0° 42′ 22″,08+0″,65 (refr. &c.)=0° 42′ 22″,73.
19 20,01	18 25,43	Line of collimation 2,92.
23 18,03	20 25,49	
25 19,07	22 24,84	
26 20,07	24 24,67	
30 19,21	29 24,08	
Oct. 3 18,98	Oct. 1 26,95	
	2 25,56	
Mean 0 42 19,16	Mean 0 42 25,01	

45 d Draconis, S.

Sept. 8—4° 40′ 25″,36	Sept. 18—4° 40′ 19″,99	Zenith dist. 4° 40′ 22″,80+4″,41 (refr. &c.)=4° 40′ 27″,21.
15 29,16	20 19,65	Line of collimation 3,65.
19 28,37	24 19,22	
23 25,07	26 19,87	
25 25,57	28 18,86	
29 25,03	Oct. 1 16,57	
30 25,57	2 19,89	
Mean 4 40 26,45	Mean 4 40 19,15	

46 *c Draconis, N.*

Face of limb, West.				Face of limb, East.			
Sept. 15	3°	7′	9″,56	Sept. 7	3°	7′	2″,31
16			10.67	10			2,19
19			9.89	18			3,58
21			9,38	20			3,58
23			9,46	22			3,13
25			8,62	24			3,62
29			8,70	26			3,10
30			9,49	28			2,61
				Oct. 1			2,51
				2			3·79
Mean	3	7	9,47	Mean	3	7	3,04

Zenith dist. 3° 7′ 6″,25+3″,05 (refr. &c.)=3° 7′ 9″,30.
Line of collimation 3,21.

51 *Draconis, N.*

Sept. 8	0°	52′	26″,01	Sept. 7	0°	52′	20″,13
16			27,89	10			23,30
19			27,60	18			21,23
23			25,70	20			20,26
25			25,98	22			20,06
29			24,59	26			20,05
30			27,43	28			19,87
				Oct. 1			21,01
				2			20,31
Mean	0	52	26,46	Mean	0	52	20,68

Zenith dist. 0° 52′ 23″,57+0″,85 (refr. &c.)=0° 52′ 24″,42.
Line of collimation 2,89.

1 *κ Cygni, N.*

Sept. 8	0°	47′	4″,07	Sept. 7	0°	46′	57″,79
15			5,02	18			59,88
16			6,59	20			58,5
18			6,13	22	47		0,44
23			5,77	24	46		59,04
25			4,06	26			58,30
29			5,67	28			58,56
30			5,82	Oct. 1			59,13
				2			58,79
Mean	0	47	5,39	Mean	0	46	58,94

Zenith dist. 0° 47′ 2″,16+0″,76 (refr. &c.)=0° 47′ 2″,92.
Line of collimation 3,22.

10 *ι Cygni.*

Sept. 19	0°	54′	35″,59	Sept. 18	0°	54′	40″,47
21			34,94	20			40,42
23			36,74	22			39,82
25			36,83	24			41,72
27			35,86	26			41,11
29			35,23	28			40,78
30			34,11	1			40,14
				2			40,24
Mean	0	54	35,62	Mean	0	54	40,59

Zenith dist. 0° 54′ 38″,21+0″,88 (refr. &c.)=0° 54″ 39′,09.
Line of collimation 2,48.

γ Ursæ, N.

Face of limb, West.	Face of limb, East.	
Sept. 23—2° 34′ 12″,07	Sept. 18—2° 34′ 5″,73	Zenith dist. 2° 34′ 9″,59+2″,29 (refr. &c.)=2° 34′ 11″,88.
26 15,28	5,29	Line of collimation 4,08.
Mean 2 34 13,67	Mean 2 34 5,51	

η Ursæ, S.

Sept. 10—1° 55′ 1″,14	Sept. 20—1° 55′ 4″,41	Zenith dist. 1° 55′ 3″,03+1″,65 (refr. &c.)=1° 55′ 4″,68.
23 54 59,80	24 4,84	Line of collimation 2,79.
25 55 2,57	26 7,75	
30 54 57,42	28 5,68	
	Oct. 3 6,41	
Mean 1 55 0,23	Mean 1 55 5,82	

ζ Ursæ, N.

Sept. 26—3° 44′ 11″,63	Sept. 24—3° 44′ 6″,99	Zenith dist. 3° 44′ 8″,63+3″,73 (refr. &c.)=3° 44′ 12″,36.
	30 4,67	Line of collimation 3,0.
	Oct. 3 5,28	
	Mean 3 44 5,64	

22 *τ Herculis, S.*

Sept. 3—5° 25′ 50″,78	Sept. 18—5° 25′ 58″,80	Zenith dist. 5° 25′ 54″,79+5″,03 (refr. &c.)=5° 25′ 59″,82.
		Line of collimation 4,01.

α Persei, S.

Sept. 16—3° 4′ 26″,57	Sept. 8—3° 4′ 30″,66	Zenith dist. 3° 4′ 29″,53+3″,07 (refr. &c.)=3° 4′ 32″,60.
18 27,69	12 31,49	Line of collimation 2,63.
23 26,22	19 32,95	
26 27,10	22 32,91	
	25 32,91	
Mean 3 4 26,89	Mean 3 40 32,18	

Capella, S.

Sept. 14—6° 26′ 12″,39	Sept. 11—6° 26′ 19″,64	Zenith dist. 6° 26′ 16″,46+6″,44 (refr. &c.)=6° 26′ 22″,90.
16 13,75	12 18,89	Line of collimation 2,89.
19 13,59	18 21,00	
21 14,68	20 19,10	
23 12,93	22 18,03	
26 14,48	25 19,64	
Mean 6 26 13,61	Mean 6 26 19,39	

Reduction of the Observations made at the Royal Observatory, and the Zenith Distances of the several Stars deduced therefrom.

β Draconis, N.

April 16—0° 58′ 37″,66	April 23—0° 58′ 28″,07	Zenith dist. 0° 58′ 32″,14+0″,99 (refr. &c.)=0° 58′ 33″,13.
25 36,02		Line of collimation 4,07.
26 34.98		
Mean 0 58 36,22		

γ *Draconis, N.*

Face of limb, West.		Face of limb, East.		
April 16	0° 2′ 28″,37	April 22	0° 2′ 19″,05	Zenith dist. 0° 2′ 24″,36 + 0″,03 (refr. &c.) = 0° 2′ 24″,39.
19	29,92	23	20,54	Line of collimation 4,57.
25	28,55			
Mean	0 2 28,94	Mean	0 2 19,79	

45 *d Draconis, N.*

April 19	5° 25′ 14″,51	April 23	5° 25′ 6″,17	Zenith dist. 5° 25′ 10″,22 + 5″,59 (refr. &c.) = 5° 25′ 15″,81.
25	14,03			Line of collimation 4,05.
Mean	5 25 14,27			

46 *c Draconis, N.*

April 25—3° 51′ 57″,64.

51 *Draconis, N.*

April 19	1° 37′ 18″,23	April 23	1° 37′ 8″,79	Zenith dist. 1° 37′ 12″,61 + 1″,54 (refr. &c.) = 1° 37′ 14″,15.
25	14,62			Line of collimation 3,81.
Mean	1 37 16,42			

1 *κ Cygni.*

April 25—1° 31′ 54″,14 April 23—1° 31′ 46″,65 Zenith dist. 1° 31′ 50″,39 + 1″,48 (refr. &c.) = 1° 31′ 51″,87.
Line of collimation 3,74.

10 *ι Cygni.*

April 19—0° 9′ 45″,02 April 23—0° 9′ 53″,90 Zenith dist. 0° 9′ 49″,41 + 0″,20 (refr. &c.) = 0° 9′ 49″,60.
Line of collimation 4,44.

γ *Ursæ.*

April 24—3° 19′ 7″,08	April 21	3° 18′ 55″,69	Zenith dist. 3° 19′ 1″,43 + 3″,24 (refr. &c.) = 3° 19′ 4″,67.
	22	55,55	Line of collimation 5,65.
	23	56,12	
	Mean	3 18 55,78	

η *Ursæ.*

April 16—1° 10′ 10″,19 April 23—1° 10′ 17″,60 Zenith dist. 1° 10′ 13″,85 + 1″,22 (refr. &c.) = 1° 10′ 15″,07.
Line of collimation 3,70.

85 *ι Herculis.*

April 16	5° 20′ 20″,47	April 23—5° 20′ 32″,04	Zenith dist. 5° 20′ 25″,10 + 5″,61 (refr. &c.) = 5° 20′ 30″,77.
19	15,87		Line of collimation 6,93.
Mean	5 20 18,17		

Capella.

April 13	5° 41′ 21″,09	April 24—5° 41′ 30″,91	Zenith dist. 5° 41′ 26″,42 + 5″,79 (refr. &c.) = 5° 41′ 32″,21.
21	22,74		Line of collimation 4,5.
Mean	5 41 21,91		

Previous to my entering on the following article, it may not be improper to exhibit, under their proper points of view, the several quantities derived from observation, expressive of the differences of the zenith distances, or the deviation of the point of intersection of the meridional and horizontal wires from the true line of collimation.

At Dunnose.

		"
β	Draconis	3,42
γ	———	3,64
45 *d*	———	4,46
46 *c*	———	3,41
51	———	3,40
μ	———	3,68
16	———	3,58
1 κ	Cygni	3,80
10 *ι*	———	3,15
γ	Ursæ	3,02
η	———	3,06
ζ	———	3,76
85 *i*	Herculis	3,46
υ	———	3,35
52	———	3,76
22 τ	———	3,16
	Capella	3,31

At Clifton.

β	Draconis	3,78
γ	———	3,30
45 *d*	———	3,72
46 *c*	———	3,47
51	———	4,15
μ	———	3,25
16	———	3,40
1 κ	Cygni	3,68

10 ι	Cygni	3,55
η	Ursæ	3,67
ζ	——	3,37
85 ι	Herculis	4,52
υ	——	4,14
52	——	4,04
22 τ	——	4,16
α	Persei	2,28
	Capella	5,30

At Arbury Hill.

β	Draconis	2,71
γ	——	2,92
45 *d*	——	3,65
46 *c*	——	3,21
51	——	2,89
1 $\varkappa$	Cygni	3,22
10 ι	——	2,48
γ	Ursæ	4,08
η	——	2,79
ζ	——	3,00
22 τ	——	4,01
α	Persei	2,63
	Capella	2,89

At Greenwich.

β	Draconis	4,07
γ	——	4,57
45 *d*	——	4,05
51	——	3,81
1 $\varkappa$	Cygni	3,74
10 ι	——	4,14
γ	Ursæ	5,65
η	——	3,70
	Capella	4,50

Amplitudes of the celestial Arc comprehended by the Stations Dunnose and Clifton.

	° ′ ″
β *Draconis.*	
Zenith distance at Dunnose	1 50 5,24
Ditto - Clifton -	1 0 17,84
Amplitude of arc - -	2 50 23,08
γ *Draconis.*	
Zenith distance at Dunnose	0 53 56,63
Clifton -	1 56 26,64
Amplitude of arc -	2 50 23,27
45 *d Draconis.*	
Zenith distance at Dunnose	6 16 47,66
Clifton -	3 26 22,92
Amplitude of arc -	2 50 24,74
51 *Draconis.*	
Zenith distance at Dunnose	2 28 44,05
Clifton -	0 21 38,12
Amplitude of arc -	2 50 22,17
46 *c Draconis.*	
Zenith distance at Dunnose	4 43 28,93
Clifton -	1 53 6,24
Amplitude of arc -	2 50 22,69
16 *Draconis.*	
Zenith distance at Dunnose	2 42 33,26
Clifton -	0 7 51,25
Amplitude of arc -	2 50 24,51
μ *Draconis.*	
Zenith distance at Dunnose	4 6 59,30
Clifton -	1 16 38,20
Amplitude of arc -	2 50 21,10
10 *ι Cygni.*	
Zenith distance at Dunnose	0 41 40,68
Clifton -	2 8 42,22
Amplitude of arc -	2 50 22,90
1 *κ Cygni.*	
Zenith distance at Dunnose	2 23 22,86
Clifton -	0 27 0,32
Amplitude of arc -	2 50 23,18

	° ′ ″
η *Ursæ.*	
Zenith distance at Dunnose	0 18 42,93
Clifton -	3 9 6,98
Amplitude of arc -	2 50 24,05
γ *Ursæ.*	
Zenith distance at Dunnose	4 10 36,23
Clifton -	1 20 13,53
Amplitude of arc -	2 50 22,70
ζ *Ursæ.*	
Zenith distance at Dunnose	5 20 35,66
Clifton -	2 30 10,37
Amplitude of arc -	2 50 25,29
52 *Herculis.*	
Zenith distance at Dunnose	4 17 1,28
Clifton -	7 7 25,45
Amplitude of arc -	2 50 24,17
85 *ι Herculis.*	
Zenith distance at Dunnose	4 30 1,95
Clifton -	7 20 24,98
Amplitude of arc -	2 50 23,03
υ *Herculis.*	
Zenith distance at Dunnose	4 1 33,24
Clifton -	6 51 56,80
Amplitude of arc -	2 50 23,56
22 *τ Herculis.*	
Zenith distance at Dunnose	3 49 37,10
Clifton -	6 40 1,29
Amplitude of arc -	2 50 24,19
Capella.	
Zenith distance at Dunnose	4 50 2,88
Clifton -	7 40 25,66
Amplitude of arc -	2 50 22,78

Amplitudes of the celestial Arc comprehended by the Stations Dunnose and Arbury Hill.

	°	′	″
β Draconis.			
Zenith distance at Dunnose	1	50	5,24
Arbury Hill	0	13	45,82
Amplitude of arc -	1	36	19,42
γ Draconis.			
Zenith distance at Dunnose	0	53	56,63
Arbury Hill	0	42	22,73
Amplitude of arc -	1	36	19,36
45 d Draconis.			
Zenith distance at Dunnose	6	16	47,66
Arbury Hill	4	40	27,21
Amplitude of arc -	1	36	20,45
51 Draconis.			
Zenith distance at Dunnose	2	28	44,01
Arbury Hill	0	52	24,42
Amplitude of arc -	1	36	19,59
46 c Draconis.			
Zenith distance at Dunnose	4	43	28,93
Arbury Hill	3	7	9,30
Amplitude of arc -	1	36	19,63

	°	′	″
1 κ Cygni.			
Zenith distance at Dunnose	2	23	22,86
Arbury Hill	0	47	2,92
Amplitude of arc -	1	36	19,94
10 ι Cygni.			
Zenith distance at Dunnose	0	41	40,68
Arbury Hill	0	54	39,09
Amplitude of arc -	1	36	19,77
η Ursæ.			
Zenith distance at Dunnose	0	18	42,93
Arbury Hill	1	55	4,63
Amplitude of arc -	1	36	21,70
Capella.			
Zenith distance at Dunnose	4	50	2,88
Arbury Hill	6	26	22,90
Amplitude of arc -	1	36	20,02

Difference between the Parallels of Latitude of Dunnose and Greenwich.

	°	′	″
β Draconis.			
Zenith distance at Dunnose	1	50	5,24
Greenwich	0	58	33,13
Difference of latitude	0	51	32,11

	°	′	″
γ Draconis.			
Zenith distance at Dunnose	0	53	56,63
Greenwich	0	2	24,39
Difference of latitude	0	51	32,24

45 *d Draconis.*	°	′	″
Zenith distance at Dunnose	6	16	47,66
Greenwich	5	25	15,81
Difference of latitude	0	51	31,85

10 *ι Cygni.*	°	′	″
Zenith distance at Dunnose	0	41	40,68
Greenwich	0	9	49,60
Difference of latitude	0	51	30,28

51 *Draconis.*	°	′	″
Zenith distance at Dunnose	2	28	44,05
Greenwich	1	37	14,25
Difference of latitude	0	51	29,90

γ Ursæ.	°	′	″
Zenith distance at Dunnose	4	10	36,23
Greenwich	3	19	4,67
Difference of latitude	0	51	31,56

1 *κ Cygni.*	°	′	″
Zenith distance at Dunnose	2	23	22,86
Greenwich	1	31	51,87
Difference of latitude	0	51	30,99

η Ursæ.	°	′	″
Zenith distance at Dunnose	0	18	42,93
Greenwich	1	10	15,07
Difference of latitude	0	51	32,14

It will now be proper to exhibit the various results, as previously deduced; the amplitudes of the several arcs will then stand as follow.

Arc between Dunnose and Clifton.

	°	′	″	
β Draconis	2	50	23,08	
γ ———			23,27	
45 *d* ———			24,75	
46 *c* ———			22,69	
51 ———			22,17	
16 ———			24,51	
μ ———			21,10	Extreme results. Mean 23″,19, and might be rejected
ζ Ursæ			25,29	
γ ———			22,70	
η ———			24,05	
1 *κ* Cygni			23,18	
10 *ι* ———			22,90	
85 *ι* Herculis			23,03	
υ ———			23,56	
52 ———			24,17	
22 *τ* ———			24,19	
Capella			22,78	
Mean amplitude	2	50	23,38	

Between Dunnose and Arbury Hill.

β Draconis	1° 36′	19″,42
γ ———		19,36
45 *d* ———		20,45
46 *c* ———		19,63
51 ———		19,59
1 $\varkappa$ Cygni		19,94
10 ι ———		19,77
η Ursæ		21,70
Mean amplitude	1 36	19,98

Between Dunnose and Greenwich.

β Draconis	0° 51′	32″,11
γ ———		32,24
45 *d* ———		31,85
51 ———		29,90
1 $\varkappa$ Cygni		30,99
10 ι ———		30,28
γ Ursæ		31,56
η ———		32,14
Mean amplitude	0 51	31,39

It is very generally known that his Grace the Duke of MARLBOROUGH is possessed of an excellent quadrant, made by the late Mr. RAMSDEN, and that he has for some years been in the habit of using it at Blenheim. As my meridional line is not far eastward from his Grace's observatory, the zenith distance of any star or stars there determined, from a course of accurate observations, must afford me the means of ascertaining the lengths of the degrees on the meridian, at the middle points between Blenheim and the two extremities of my arc. I therefore applied to his Grace, requesting him to favour me with any observations he might have made, and with permission to publish

them, if I thought proper. His Grace was pleased to comply with my request; and I now avail myself of the advantage procured by that condescension.

Blenheim Observatory.

Zenith Distances of γ *Draconis, reduced to the Beginning of the Year* 1794, *from Observations made in five successive Years, by his Grace the Duke of* MARLBOROUGH.

From the observations of 1794, 0° 19′ 17″,32 γ Draconis south of the
1795 17,70 zenith.
1796 17,51
1797 17,48
1798 17,32

Mean 0 19 17,46. Therefore, the mean zenith distance of γ Draconis, at Blenheim, on the 1st of January, 1802, may be taken at 0° 19′ 23″,06 south. The zenith distance of this star, at the same period, at the station Dunnose, as derived from the late operation, is 0° 53′ 56″,63 north; therefore, 0° 53′ 56″,63 + 0° 19′ 23″,06 = 1° 13′ 19″,69, is the difference of latitude between Dunnose and Blenheim observatory; and here, perhaps, it may not be improper to advert to page 675 of the Phil. Trans. for 1800, where the observed and computed latitudes are given, the former being 51° 50′ 24″.9, and the latter 51° 50′ 28″,1. The latitude of Dunnose is 50° 37′ 8″,21, that of Greenwich being taken at 51° 28′ 40″; and their difference 0° 51′ 31″,39, as derived from the observations made with the new sector. Hence, 50° 37′ 8″,21 + 1° 13′ 19″,69 = 51° 50′ 27″,9, must be the latitude of Blenheim, within a small part of a second of the truth. But it will be improper to dwell on this matter at present; and, therefore, I

shall conclude this article with giving, in order, the subtenses in the heavens, of the different parts of my terrestrial arc.

1.	Dunnose and Clifton - -	2° 50′ 23″,38
2.	Dunnose and Arbury Hill -	1 36 19,98
3.	Arbury Hill and Clifton - -	1 14 3,40
4.	Dunnose and Greenwich -	0 51 31,39
5.	Greenwich and Clifton - -	1 58 51,59
6.	Arbury Hill and Greenwich -	0 44 48,19
7.	Dunnose and Blenheim -	1 13 19,69
8.	Blenheim and Clifton - -	1 37 3,69

Determination of the Lengths of the Degrees on the Meridian, in the middle Points of the several Arcs given in the last Article.

On a reference to the Phil. Trans. for 1800, it will be found, that Blenheim Observatory is 446458 feet from the perpendicular to the meridian of Dunnose. But the parallel to the perpendicular at Dunnose, from that observatory, where it cuts the meridian of the former, is about $\frac{4}{10}$ of a second in latitude north of the latter; therefore, 446498 feet may be taken for the distance of Blenheim north of Dunnose. This premised, we have the following terrestrial arcs, in conjunction with the preceding celestial ones, for computing the lengths of the several degrees.

	Arcs.	Feet.
1.	Dunnose and Clifton - -	1036337
2.	Dunnose and Arbury Hill - -	586320
3.	Arbury Hill and Clifton - -	450017
4.	Dunnose and Greenwich -	313696
5.	Greenwich and Clifton - -	722641
6.	Arbury Hill and Greenwich -	272624
7.	Dunnose and Blenheim - -	446498
8.	Blenheim and Clifton - -	589839

And, by simply dividing the terrestrial arcs by their corresponding celestial ones, and afterwards multiplying the several quotients by 3600″, we shall get the lengths of the degrees as follows.

	Fathoms.
Middle point between Dunnose and Clifton -	60820
Dunnose and Arbury Hill -	60864
Arbury Hill and Clifton -	60766
Dunnose and Greenwich -	60884
Greenwich and Clifton -	60794
Arbury Hill and Greenwich	60849
Blenheim and Clifton -	60769
Blenheim and Dunnose -	60890

Taking the latitude of Greenwich at 51° 28′ 40″, from the several arcs now given, the latitudes of their middle points are easily found; and, with the lengths of the degrees, when properly arranged, will stand as follows.

	Latitude of middle point.	Fathoms.
Arbury Hill and Clifton -	52° 50′ 29″,8	60766
Blenheim and Clifton - -	52 38 56,1	60769
Greenwich and Clifton -	52 28 5,7	60794
Dunnose and Clifton - -	52 2 19,8	60820
Arbury Hill and Greenwich	51 51 4,1	60849
Dunnose and Arbury Hill -	51 35 18,2	60864
Blenheim and Dunnose -	51 13 18,2	60890
Dunnose and Greenwich -	51 2 54,2	60884

Note. The altitude of Arbury Hill, above the level of the sea, is 804 feet. The altitudes of the stations southward of Arbury Hill, are given in the former accounts of the trigonometrical operations: those to the northward of Arbury Hill may be found from the following *data*.

At Sutton, Heathersedge, elev. 15′ 25″; Gringley, dep. 18′ 47″.—*At Castle Ring*, Orpit Heights, dep. 5′ 26″; Bardon Hill, dep 6′ 48″; Corley, dep. 14′ 26″.—*At Heathersedge*, Orpit Heights, dep. 20′ 27″.—*At Clifton*, Heathersedge, elev. 29′ 12″; Gringley, dep 13′ 40″.—*At Hollan Hill*, Bardon Hill, elev 2′ 35″; Orpit Heights, elev. 12′ 0″; Sutton, elev. 7′ 12″.—*At Bardon Hill*, Corley, dep. 16′ 3″; Arbury Hill, dep. 16′ 0″; Castle Ring, dep. 12′ 30″; Sutton, dep. 19′ 48″; Orpit Heights, dep. 6′ 35″.

CONCLUSION.

From this measurement it appears, that the length of a degree on the meridian, in latitude 52° 2′ 20″, is 60820 fathoms. This conclusion is deduced from the supposition of the whole arc subtending an angle of 2° 50′ 23″,38 in the heavens, and a distance of 1036337 feet on the surface of the earth.

The length of the degree at the middle point (51° 35′ 18″) between the southern extremity of the arc and Arbury Hill, is 60864 fathoms; which is greater than the above, and exceeds it by 44 fathoms. But this degree, admitting the earth to be an ellipsoid, with the ratio of its axes as 229 to 230, should be about 10 fathoms less. If the measurement of the terrestrial arc be sufficiently correct, and the earth of an elliptical form in these latitudes, either the arcs affording the deductions are incorrect, or some material deflection of the plumb-line has taken place, at one or two stations, from the effect of attraction.

Without arrogating to myself any merit from the pains taken in the performance of this undertaking, I may say, I am so perfectly convinced of the general accuracy of the whole, that I cannot for a moment doubt the collective evidence of its sufficiency. From an examination of my field books, and from the remeasurement of the chains used in our base-line on Misterton Carr, I think it is probable that an error in the whole distance, of 197 miles nearly, does not subsist to an amount of more than 100 feet, corresponding to 1″ in the amplitude of the whole arc; and I also think it probable it cannot amount to half that quantity. The supposition of the zenith distances of the stars being generally erroneous, at any one station, cannot be admitted, unless it should be imagined, that the plane of the

sector's limb was not got into that of the meridian. Such an idea, however, can scarcely be entertained, after a careful examination of the several observations, and a due attention to the means by which the instrument was made to assume its right position. Perhaps, also, I should not fail to observe, in this place, that although the instrument was always brought into the plane of each meridian by means of the telescope attached to the side of the great tube, and the azimuth circle, yet, having two good chronometers in my possession, I repeatedly verified the truth of the sector's position, by observing the transits of two stars, north and south of the zenith, at the greatest distances my arc would admit of. But, to return, if there be an error in the amplitude of the total arc, from a deflection of the plumb-line at either of the stations, it is not probable that any such deflection existed at Dunnose; as the deviation of it towards the north, from a deficiency of matter towards the channel, would tend to diminish the inequality between the lengths of the two degrees. This will be evident, on consideration. I am therefore disposed to believe that the plumb-line was drawn towards the south, from the action of matter, both at the northern extremity of the arc and at Arbury Hill, but more particularly at the first-mentioned station. If this were partly the case, and both Dunnose and Arbury Hill were free from any such prevailing cause, the total arc must be too great, if taken at $2^{\circ}\ 50'\ 23'',38$, by about $8''$, nearly answering to $2''$ on each degree. A deviation of $8''$ from the true vertical, is a large quantity; nor can the cause of it be assigned, unless it be also supposed, that the matter producing that deflection extends in a southern direction *beyond* Arbury Hill. If the error, though not probable, as above observed, be supposed to exist at Dunnose, it must amount to

more than 10″; and that too from the effects of attraction in a southern direction, where the deficiency of matter would lead us to believe the reverse would happen.

I am perfectly aware that it is possible to state a case, in which the plumb-line of a sector would deviate from the true vertical by such a quantity. Thus, for instance, in a chalky county, like the southern part of the kingdom, if the instrument were set up adjoining the terminations of two strata running east and west, one of chalk and the other of much denser materials, the effect would be as we have found it. But, at Dunnose, this argument does not apply; nor is there reason to believe, from external appearances, that it will do so, with regard either to Arbury Hill or the northern extremity of the meridional line.

It was the discovery of the disagreement between the subtense in the heavens, of the whole arc, and its corresponding terrestrial one, with those of its parts, which led me to apply to his Grace the Duke of MARLBOROUGH, for the observations made at Blenheim on γ Draconis, or some other star. His Lordship's compliance with my request, is shown, from the Table of results, to be serviceable; as the arc contained between the observatory at Blenheim and Dunnose, deduced from his Grace's observations, and those made at the latter place, with the meridional distance 446498 feet, give 60890 fathoms, for the length of the degree on the meridian in latitude 51° 13′; which agrees nearly with the length of the degree at the middle point between Greenwich and Dunnose. However, under all considerations of the means by which the degree in 51° 13′ has been obtained, I am inclined to believe there is an uncertainty in it, of 6 or 7 fathoms, answering to about $\frac{1}{2}$″ in latitude.

But, if the measured space between his Grace's observatory and

Dunnose, with its amplitude, (1° 13′ 19″,69) be used in finding the meridional distance of the whole arc, (its corresponding amplitude,) we shall get 2° 50′ 11″,80 for its subtense; which argues a deflection from the vertical at Clifton = 11″,79. If the meridional distance between Dunnose and Greenwich be used, we shall, from the same mode of proceeding, make it = 10″,3. In short, the general tenor of the observations seems to prove, that the plumb-line of the sector has been drawn towards the south at all the stations; and that by attractive forces, which increase as we proceed northward. On a further prosecution of this Survey, the zenith sector will be taken forward in that direction, which will afford an opportunity of throwing further light on this interesting subject. But meridional operations carried on in insular countries, are not so likely to afford just conclusions with regard to the different lengths of the degrees, as the same operations conducted in places very remote from deep seas.

From the late operations of the French Academicians it appears, that the meridional distance between Dunkirk and Barcelona is 275792,36 modules, the metre being 443,296 lines of the Peru toise = 0,256537th part of the module, at the temperature of melting ice. This meridional distance, therefore, converted into English feet, is 3527921. The distance between Dunkirk and Paris is 133758 feet, and the distance between Paris and Greenwich = 963954 feet; therefore, 830196 feet is the distance between Greenwich and Dunkirk. The distance between Greenwich and Clifton is 722641 feet; hence, 4411968 feet is the meridional distance between Clifton and Barcelona. The latitude of Barcelona is 41° 21′ 48″,8; the latitude of Greenwich is 51° 28′ 40″; and if to this latitude we add 1° 58′ 51″,59, the arc between Clifton and Greenwich, we shall get

53° 27′ 31″,59 for the latitude of Clifton; and shall then have the difference of latitude between Barcelona and Clifton = 12° 5′ 42″,79, something more than the 30th part of the whole circumference of the earth. With this difference of latitude, and the abovementioned distance, we shall get 60795 fathoms, for the mean length of a degree on the earth's surface, in latitude 47° 24′. The latitude of Paris is 48° 50′ 15″; this, with that of Clifton, gives 4° 37′ 16″,59 for the difference between their parallels. The meridional distance is 1686595 feet; hence, 60825 fathoms, is the length of the degree in latitude 51° 9′.

With regard to the latitudes of places published in our former papers, those referred to the meridian of Greenwich are to remain uncorrected, since the computations were made with nearly the same length of a degree on the meridian, as that at the middle point, now deduced, between Dunnose and Greenwich, *viz.* 60884 fathoms. As to those places referred to the new meridian, *viz.* Dunnose, Butterton, and St. Agnes Beacon, 1″ is to be added to the latitudes of them all; because the latitude of Dunnose became the standard, which was then computed to be 50° 37′ 7″,3, but is now found, from the zenith distances of the stars observed there and at Greenwich, to be 50° 37′ 8″,2.

By way of Appendix to this Paper, I shall subjoin the latitudes and longitudes of those places intersected in the survey of Essex, Suffolk, &c. whose distances from their respective places of observation are given in the Phil. Trans. for 1800; this cannot but be highly useful, as they may be depended on, the interior survey of those parts having since proved that no erroneous intersections were made.

APPENDIX.

Bearings of the principal Stations in the Counties of Essex, &c. from the Parallels to the Meridian of Greenwich; and likewise their Distances from that Meridian.

Names of stations.		Bearings.				Distance from meridian.	Mean.		Distance from perpendicular.	Mean.	
		°	′	″		Feet.	Feet.		Feet.	Feet.	
Severndroog	New Station, Wrotham	46	27	19	SE	71978	71977	E	59145	59144½	S
Old Station, Wrotham		38	43	11	NE	71976			59144		
Severndroog	Gravesend	80	53	20	SE	84888	84888½	E	15434	15433½	S
New Station, Wrotham		16	27	19	NE	84889			15433		
Severndroog	Langdon Hill	68	48	4	NE	96515	96515	E	27920	27920½	N
Gravesend		15	0	39	NE	96515			27921		
Gravesend	Hadleigh	49	32	32	NE	133643	133643½	E	26145	26145	N
Langdon Hill		87	15	37	SE	133644			26145		
Hadleigh	Halstow	7	45	59	SW	129041	129040	E	7607	7607	S
Gravesend		79	56	53	NE	129039			7607		
Gravesend	Gads Hill	63	24	46	SE	105603	105603	E	23629	23629	S
Halstow		55	38	32	SW	105603			23629		
Gad's Hill	Sheppey	88	46	1	NE	176273	176273	E	22108	22108½	S
Halstow		72	55	56	SE	176273			22109		
Hadleigh	South End	80	11	2	SE	160836	160836	E	21441	21441	N
Sheppey		19	31	7	NW	160836			21441		
Halstow	Rayleigh	11	17	7	NE	138709	138709½	E	40851	40850½	N
Sheppey		30	49	17	NW	138710			40850		
Halstow	Prittlewell	42	47	6	NE	160844	160844	E	26757	26756½	N
Sheppey		17	31	22	NW	160844			26756		
Halstow	Canewdon	33	18	22	SE	168413	168413	E	51908	51907½	N
Sheppey		6	16	7	NW	168413			51907		
Halstow	Flagstaff, Shoerness	86	3	48	SE	170376	170374½	E	10451	10449	S
Hadleigh		45	6	25	SE	170373			10447		
Rayleigh	Danbury	9	55	10	NW	130525	130528½	E	87654	87664	N
Frierning		71	57	58	NE	130531			87664		
Langdon Hill		29	39	21	NE	130530			87662		
Severndroog	Frierning	42	23	31	NE	83919	83919	E	72488	72487½	N
Langdon Hill		15	46	56	NE	83919			72487		
Rayleigh	Signal Staff, Shoeburyness	59	55	0	SE	179732	179734	E	17086	17089	N
Langdon Hill		32	35	14	SE	179736			17093		
Rayleigh	Old Station, Tiptree	13	45	9	NE	156314	156314	E	112779	112785	N
Danbury		45	44	2	NE	156310			112790		
Frierning		60	53	59	NE	156320			112786		
Tiptree*	Tillingham Steeple	54	44	17	SE	200547	200544½	E	81511	81514	N
Danbury		84	58	57	SE	200542			81518		

* Triptree, by mistake, in the former part of this Survey.

Names of stations.		Bearings.			Distance from meridian.	Mean.		Distance from perpendicular	Mean.	
		°	′	″	Feet.	Feet.		Feet.	Feet.	
Danbury -	Peldon	62	33	13 NE	200463	200464	E	123986	123984	N
Tillingham -		0	6	23 NW	200465			123983		
Peldon -	Flagstaff, St. Osyth Priory	83	48	39 SE	243805	243808	E	119284	119283	N
Tillingham -		48	52	57 NE	243812			119282		
Danbury -	Great Tey Steeple	30	12	45 NE	169380	169381	E	154381	154381	N
Peldon - -		45	38	20 NW	169382			154381		
Peldon -	Stoke Steeple	0	35	41 NE	201127	201127	E	187921	187921	N
Great Tey -		43	25	34 NE	201127			187921		
Peldon -	Thorp Steeple	75	21	46 NE	263163	263163	E	140362	140359	N
Stoke - -		52	30	43 SE	263164			140358		
Peldon -	Little Bentley	60	4	57 NE	244846	244846	E	149523	149523	N
Thorp - -		63	25	21 NW	244846			149523		
Little Bentley	Dover Court	63	32	9 NE	283323	283322	E	168677	168676	N
Thorp -		35	26	59 NE	283321			168675		
Tillingham -	West Mersea	11	58	27 NE	206545	206544	E	109809	109810	N
Danbury -		73	45	20 NE	206543			109811		
Great Tey	St. Mary's, Colchester	84	22	42 SE	202276	202276	E	151143	151143	N
Stoke - -		1	47	26 SE	202276			151143		
St. Mary's Colchester -	Little Bromley	76	2	46 NE	234987	234987	E	159270	159270	N
Stoke -		49	45	52 SE	234988			159270		
Thorp - -	Tattingstone	14	37	54 NW	250358	250353	E	189406	189402	N
Dover Court		57	50	38 NW	250351			189405		
Stoke -		88	17	13 NE	250350			189393		
Tattingstone	Rushmere	35	36	22 NE	270865	270864	E	218047	218048	N
Dover Court		14	9	47 NW	270864			218050		
Rushmere -	Falkenham	52	35	7 SE	302055	302054	E	194188	194189	N
Dover Court		36	17	7 NE	302054			194190		
Rushmere -	Woodbridge	69	24	43 NE	295524	295524	E	227311	227311	N
Falkenham		11	9	17 NW	295524			227312		
Woodbridge	Butley Steeple	85	40	43 NE	329485	329485	E	229878	229878	N
Falkenham -		37	32	43 NE	329485			229879		
Falkenham	Light House, Orford	59	30	44 NE	354267	354266	E	224929	224929	N
Butley -		78	42	16 SE	354266			224931		
Rushmere -	Otley Steeple	6	39	43 NE	274256	274254	E	247089	247088	N
Woodbridge		47	5	17 NW	274252			247087		
Otley - -	Henley Steeple	53	4	43 SW	259074	259075	E	235681	235681	N
Rushmere -		33	45	47 NW	259076			235681		
Henley -	Copdock Steeple	23	3	13 SW	245556	245557	E	203918	203917	N
Rushmere -		60	49	13 SW	245559			203917		
Copdock -	Naughton Steeple	51	26	57 NW	214045	214045	E	229030	229030	N
Henley - -		81	35	53 SW	214046			229030		
Great Tey -	Twinstead Steeple	12	47	14 NW	161215	161206	E	161198	161198	N
Stoke - -		86	26	30 NW	161198			161198		
Stoke -	Lavenham	28	18	20 NW	178348	178348	E	230216	230216	N
Glemsford -		87	4	35 NE	178348			230216		
Stoke -	Bulmer	73	17	13 NW	154916	154915	E	201792	201792	N
Lavenham -		39	30	10 SW	154915			201793		

Names of stations.		Bearings.	Distance from meridian.	Mean.	Distance from perpendicular.	Mean.
		° ′ ″	Feet.	Feet.	Feet.	Feet.
Lavenham -	Glemsford	87 4 35 SW	152635	152636 E	228903	228903 N
Bulmer - -		4 48 30 NW	152636		228903	
Bulmer -	Toppesfield *	77 14 50 SW	120796	120796 E	194070	19 069 N
Lavenham -		57 52 10 SW	120796		194069	
Severndroog	Southweald	39 49 54 NE	61300	61298 E	52599	52596 N
Langdon Hill		54 59 11 NW	61296		52593	
Tiptree -	Gallywood Common	57 45 6 SW	120796	120796 E	80657	80658 N
Danbury -		74 25 56 SW	120796		80659	
Gallywood Common - -	Pleshey *	17 28 50 NW	93384	93385 E	118789	118787 N
Tiptree -		84 33 10 NW	93386		118786	
Gallywood Common - -	High Easter	33 14 20 NW	79208	79208 E	120610	120611 N
Pleshey -		82 39 50 NW	79209		120612	
Danbury -	Hatfield Oak	62 7 31 NW	55309	55306 E	127468	127466 N
Pleshey -		77 9 51 NW	55303		127464	
Pleshey - -	Beauchamp Roding	63 25 9 SW	64941	64940 E	104555	104555 N
Hatfield Oak		22 49 0 SE	64940		104556	
Danbury -	Thaxted	31 33 51 NW	77490	77481 E	174002	173995 N
Lavenham -		60 52 10 SW	77475		174000	
Stoke - -		83 34 10 SW	77480		173985	
Severndroog	Brentwood Spire	44 23 29 NE	68984	68984 E	52063	52061 N
Langdon Hill		48 45 17 NW	68984		52060	
St. Paul's -	Old Station, High Beech	29 8 28 NE	8117	8117 E	67219	67219 N
Severndroog		4 44 36 NW	8117		67219	
St. Paul's -	Station, Hampstead	43 14 15 NW	39822	39824 W	32055	32055 N
High Beech -		53 44 33 SW	39826		32056	
St. Paul's -	New Station, High Beech	28 45 2 NE	7661	7661 E	67265	67264 N
Old Station, High Beech -		84 18 44 NW	7661		67264	
High Beech -	Epping Mill	53 4 40 NE	21742	21742 E	77457	77457 N
Severndroog		5 24 9 NE	21742		77457	
High Beech -	Berkhampstead Gazebo	46 15 36 NW	27987	27990 W	101790	101788 N
Epping Mill		63 56 1 NW	27993		101786	
Hatfield Oak -	Nasing Steeple	55 36 7 SW	10875	10875 E	97046	97046 N
Hatfield Oak	Henham on the Mount	0 35 42 NE	55710	55701 E	166727	166701 N
Thaxted -		71 24 58 SW	55692		166674	
Henham -	Thorley Steeple	36 40 8 SW	32376	32366 E	135373	135377 N
Hatfield -		70 57 48 NW	32356		135381	
Henham - -	Elmdon	35 5 52 NW	29669	29664 E	203744	203730 N
Thaxted -		58 8 32 NW	29660		203717	
Elmdon -	Rickling	22 34 52 SE	40925	40928 E	176651	176657 N
Henham -		55 59 52 NW	40931		176664	
Elmdon - -	Albury	11 37 43 SW	19669	19660 E	155071	155072 N
Henham -		72 6 30 SW	19651		155073	
Elmdon -	Balsham	49 57 18 NE	71969	71969 E	239285	239278 N
Thaxted -		4 49 38 NW	71970		239272	

* Topplesfield, } by mistake, in the former part of this Survey.
* Pleshley, }

Names of stations.		Bearings.				Distance from meridian.	Mean.		Distance from perpendicular.	Mean.	
		°	′	″		Feet.	Feet.		Feet.	Feet.	
Elmdon -	Babraham	26	18	52	NE	48970	48976	E	242777	242770	N
Balsham -	Mount	81	22	4	NW	48982			242762		
Elmdon -	Triplow	13	27	58	NW	23888	23891	E	227854	227850	N
BabrahamMount		59	15	2	SW	23894			227846		
Langdon Hill	Hornchurch	87	1	36	NW	51738	51747	E	30245	30246	N
Severndroog		47	41	55	NE	51744			30248		
Gravesend -	Purfleet Cliff	60	30	51	NW	53972	53974	E	2048	2050	N
Hornchurch -		4	31	59	SE	53976			2050		
Severndroog	Barking	7	57	53	NE	17541	17544	E	20068	21069	N
Hornchurch -		74	58	39	SW	17547			21070		
St. Paul's -	Westham	71	14	54	NE	2265	2264	E	21387	21387	N
Severndroog		24	48	33	NW	2264			21388		

Bearings of secondary Objects, &c.

Severndroog	Chigwell	4	30	54	NE	18578	18581	E	53508	53510	N
Higbeech -		37	21	14	SE	18585			53513		
Severndroog	Billericay	54	20	37	NE	95374	95373	E	54286	54286	N
Frierning -	Chapel	32	10	59	SE	95373			54286		
Hornchurch	Chimney of	60	27	19	SW	22826	22821	E	13857	13855	N
Barking -	Public House	36	9	21	SE	22817			13853		
Purfleet Cliff	Rainham	38	43	29	NW	43722	43723	E	14835	14835	N
Hornchurch -	Steeple	27	29	1	SW	43725			14836		
Hornchurch	Belvidere	27	18	51	SW	37806	37807	E	3263	3266	N
Purfleet -		85	40	59	NW	37808			3270		
Hornchurch -	Valence Tree	89	28	19	NW	31338	31335	E	30434	30432	N
Purfleet -		38	34	59	NW	31332			30430		
Rainham -	Cold Harbour	3	1	31	SW	43138	43137	E	3762	3761	N
Purfleet -		81	1	59	NW	43137			3760		
Gravesend -	Chadwell	1	13	50	NW	84524	84524	E	1570	1570	N
Severndroog	Steeple	85	25	30	NE	84524			1571		
Gravesend -	Greys Steeple	36	52	50	NW	73799	73799	E	653	653	S
Chadwell -		78	17	30	SW	73799			653		
Gravesend -	Flagstaff, Mr.	38	59	50	NW	70491	70491	E	2348	2347	N
Chadwell -	Button's	86	49	50	NW	70491			2347		
Gravesend -	West Tour-	52	56	50	NW	66967	66967	E	1902	1902	S
Chadwell -	rock Steeple	78	48	40	SW	66967			1903		
Gravesend -	West Tilbury	17	38	10	NE	89420	89420	E	1181	1181	S
Chadwell -	Steeple	60	40	20	SE	89421			1181		
Gravesend -	Northfleet	70	45	17	NW	76623	76623	E	12548	12548	S
Chadwell -	Steeple	29	13	52	SW	76623			12549		
Gravesend -	Horndon Spire	13	10	9	NE	92494	92496	E	17070	17072	N
Hornchurch -		72	5	26	SE	92498			17074		
Gravesend -	Flagstaff, East	56	2	10	NE	98431	98431	E	6312	6312	S
Chadwell -	Tilbury	60	27	20	SE	98432			6313		
Gravesend -	Fobbing	34	47	40	NE	108532	108534	E	18591	18591	N
Halstow -	Steeple	38	2	57	NW	108535			18592		

Names of stations.		Bearings.				Distance from meridian.	Mean.		Distance from perpendicular.	Mean.	
		°	′	″		Feet.	Feet.		Feet.	Feet.	
Halstow	Thundersley Steeple	1	36	20	NE	—	130198	E	—	33719	N
Sheppey	Leigh Steeple	30	29	48	NW	149211	149211	E	23840	23839	N
Halstow		32	40	43	NE	149211			23838		
Prittlewell	Little Wakering Steeple	76	58	11	NE	179943	179940	E	31175	31176	N
Canewdon		29	38	19	SE	179937			31178		
Prittlewell	Bank Flagstaff	83	58	11	NE	192575	192572	E	30108	30109	N
Canewdon		48	15	19	SE	192570			30110		
Bank Flagstaff	Foulness Chapel	33	4	41	NE	203200	203199	E	46426	46426	N
Canewdon		81	6	49	SE	203198			46427		
Tillingham	Tillingham Grange Signal Staff	40	45	13	SE	209676	209676	E	70916	70917	N
Peldon		9	50	52	SE	209676			70918		
Tillingham	Bradwell Point	43	21	35	NE	213453	213453	E	95184	95185	N
Peldon	Signal Staff	24	16	41	SE	213453			95187		
Tillingham	Brightlingsea	30	56	17	NE	229383	229382	E	129627	129627	N
Peldon	Steeple	78	57	17	NE	229381			129628		
Tillingham	Toleshunt	47	39	58	NW	173531	173531	E	106122	106123	N
Peldon	Major	56	27	2	SW	173531			106124		
Tillingham	Tolesbury	27	50	13	NW	189052	189051	E	103277	103278	N
West Mersea	Steeple	69	31	40	SW	189050			103279		
Tillingham	Althorn	61	20	37	SW	172511	172512	E	66194	66192	N
Tiptree	Steeple	19	10	14	SE	172513			66191		
Althorn	Burnham	62	50	23	SE	185324	185324	E	59619	59620	N
Tillingham	Steeple	34	48	27	SW	185324			59621		
Langdon Hill	Rettenden	45	18	38	NE	126748	126747	E	57827	57822	N
Rayleigh	Steeple	35	11	19	NW	126747			57817		
Langdon Hill	Runwell	44	47	13	NE	121154	121151	E	52743	52740	N
Rayleigh	Steeple	55	54	27	NW	121148			52737		
Rayleigh	GreatBurstead	82	34	27	NW	96984	96987	E	46288	46293	N
Danbury	Steeple *	39	2	12	SW	96990			46299		
Gallywood Common	East Hanningfield Steeple	63	53	54	SE	125885	125884	E	70617	70618	N
Danbury		15	14	49	SW	125884			70619		
Canewdon	Hockley	82	24	42	SW	144794	144796	E	48798	48798	N
Danbury	Steeple	20	9	38	SE	144799			48798		
Rettenden	Stow, St.	63	26	42	NE	147833	147836	E	68360	63358	N
Canewdon	Mary's	50	59	18	NW	147839			68357		
Frierning	Stock Steeple	71	54	14	SE	99912	99912	E	67262	67261	N
Danbury		56	19	22	SW	99912			67261		
Tiptree	Southminster	36	6	6	SE	188765	188762	E	68286	68289	N
Tillingham	Steeple	41	42	29	SW	188760			68292		
Peldon	Layer Marney	82	30	52	NW	180456	180457	E	126613	126612	N
Tillingham	Steeple	24	0	27	NW	180458			126612		
Peldon	St Osyth Point	80	26	29	SE	260322	260323	E	113906	113905	N
Tillingham	Signal Staff	61	33	1	NE	260324			113904		
Thorp Steeple	Great Clacton Sig. Staff	26	32	57	SE	272780	272780	E	121112	121111	N
Little Bentley		44	30	52	SE	272780			121111		

* Great Burghstead, by mistake, in the former part of this Survey.

Names of stations.		Bearings.				Distance from meridian.	Mean.			Distance from perpendicular.	Mean.		
		°	′	″		Feet.	Feet.			Feet.	Feet.		
Dover Court	Frinton *	10	50	11	SW	275991	275991	E		130375	130375	N	
Thorp Steeple	Steeple	52	6	20	SE	275992				130375			
Thorp -	Great Clack-	3	45	53	SW	261921	261921	E		121481	121481	N	
Peldon - -	ton Steeple	87	40	1	SE	261921				121481			
Dover Court -	Frinton Signal	3	49	35	SE	285637	285638	E		134068	134068	N	
Thorp -	Staff	74	21	45	SE	285639				134068			
Dover Court	Walton Tower	17	48	27	SE	291358	291358	E		143661	143661	N	
Thorp -		83	19	21	NE	291359				143661			
Dover Court	Cupola, Lan-	81	29	29	NE	298242	298242	E		170909	170909	N	
Thorp - -	guard Fort	48	56	56	NE	298243				170909			
Thorp -	Ardleigh	58	21	57	NW	222726	222726	E		165270	165267	N	
Peldon	Steeple	28	20	12	NE	222726				165265			
Great Tey -	Frating	78	10	31	SE	231313	231313	E		141415	141414	N	
Peldon -	Steeple	60	31	56	NE	231313				141414			
Thorp -	Thorrington	86	16	44	SW	239323	239323	E		138810	138809	N	
Little Bentley	Steeple	27	16	2	SW	239324				138809			
Thorp -	Kirby Steeple	84	44	24	SE	276355	276354	E		139146	139146	N	
Dover Court -		13	16	47	SW	276353				139146			
Dover Court	Brantham	74	38	51	NW	242253	242254	E		179953	179951	N	
Tattingstone	Steeple	40	35	22	SW	242255				179950			
Dover Court	Harwich	58	39	3	NE	290907	290909	E		173297	173297	N	
Rushmere -	Steeple	24	7	47	SE	290911				173297			
Kirby Steeple	Little Oakley	5	5	13	NW	274475	274474	E		160255	160255	N	
Dover Court		46	24	59	SW	274474				160255			
Dover Court -	Bawdsey	51	49	28	NE	319624	319624	E		197218	197217	N	
Rushmere -	Steeple	66	51	57	SE	319025				197216			
Dover Court	Harkstead	45	2	45	NW	269208	269208	E		182770	182769	N	
Rushmere -	Steeple	2	41	15	SW	269209				182768			
Dover Court -	Arwarton	24	33	8	NW	277899	277902	E		180550	180547	N	
Tattingstone	Steeple	72	10	38	SE	277905				180544			
Tattingstone	Bradfield	6	0	38	SE	252552	252551	E		168520	168521	N	
Arwarton -	Steeple	64	37	22	SW	252550				168523			
Falkenham -	Orford Steeple	51	16	53	NE	345336	345342	E		228887	228881	N	
Rushmere -		81	43	43	NE	345349				228876			
Falkenham	Nacton Steeple	83	34	7	NW	277115	277115	E		197000	196998	N	
Rushmere -		16	32	17	SE	277115				196997			
Dover Court	Capel Steeple	63	18	59	NW	233984	233986	E		193474	193468	N	
Stoke -		80	25	43	NE	233988				193462			
Stoke - -	Great Horks-	22	8	14	SW	195997	195997	E		175309	175309	N	
Great Tey -	ley Steeple	51	49	14	NE	195997				175310			
Great Horksley	Mount Bures	87	34	46	NW	174196	174195	E		176230	176230	N	
Stoke -	Steeple	66	32	14	SW	174194				176231			
Rushmere -	Hollesley	82	8	17	SE	322258	322258	E		210952	210953	N	
Dover Court	Steeple	42	38	33	NE	322258				210955			
Rushmere -	Shottisham	82	14	7	SE	311711	311720	E		212477	212477	N	
Dover Court	Steeple	32	57	53	NE	311729				212477			
Woodbridge	Felixstow Sig-	16	45	47	SE	309444	309444	E		181100	181102	N	
Dover Court -	nal Staff	64	33	24	NE	309444				181104			

* Finton, by mistake, in the former part of this Survey.

Names of stations.		Bearings.				Distance from meridian.	Mean.		Distance from perpendicular.	Mean.	
		°	′	″		Feet.	Feet.		Feet.	Feet.	
Woodbridge -	Bawdsey Sig-	33	7	47	SE	318758	318757	E	191712	191714	N
Dover Court	nal Staff	56	58	8	NE	318757			191716		
Butley -	Rendlesham	59	42	17	NW	313767	313761	E	239061	239058	N
Woodbridge	Steeple	57	12	43	NE	313755			239055		
Dover Court	Kesgrave	6	7	41	NW	278145	278145	E	216905	216904	N
Rushmere -	Steeple	81	3	47	SE	278146			216903		
Dover Court -	Waldringfield	20	4	29	NE	298893	298901	E	211282	211281	N
Rushmere -	Steeple	76	25	37	SE	298900			211282		
Dover Court	Whertstead	37	5	51	NW	258996	258995	E	200845	200844	N
Kesgrave -	Steeple	50	0	49	SW	258995			200843		
Capel Steeple	Hintlesham	3	26	17	NE	235016	235017	E	210623	210620	N
Stoke -	Steeple	56	11	25	NE	235019			210618		
Stoke - -	Bildestone	1	24	50	NE	202169	202168	E	230147	230147	N
Lavenham -	Steeple	89	50	0	SE	202168			230147		
Stoke - -	Aldham	35	18	30	NE	219654	219654	E	214079	214080	N
Bildeston -	Steeple	47	25	20	SE	219654			214081		
Naughton -	Hadleigh	1	12	40	SE	214492	214565	E	207881	207823	N
Lavenham -	Steeple	58	15	30	SE	214639			207766		
Naughton -	Lindsey	49	42	50	SW	199105	199177	E	216365	216308	N
Lavenham -	Steeple	56	15	10	SE	199249			216251		
Stoke -	Newton	51	25	50	NW	179897	179897	E	204850	204850	N
Lavenham -	Steeple	3	29	40	SE	179897			204850		
Stoke -	Grotton	24	24	50	NW	193001	193001	E	205823	205823	N
Newton -	Steeple	85	45	10	NE	193001			205823		
Bulmer -	Waldingfield	62	39	10	NE	177687	177690	E	213569	213540	N
Glemsford -	Steeple	58	26	20	SE	177693			213511		
Glemsford -	Acton Steeple	59	48	35	SE	171295	171295	E	218047	218047	N
Lavenham -		30	5	35	SW	171296			218047		
Bulmer -	Beauchamp	51	50	10	NW	140480	140478	E	213137	213135	N
Lavenham -	Ch. St. Paul's	95	43	20	SW	140476			213134		
Lavenham -	Hedingham	45	20	20	SW	136127	136128	E	188492	188492	N
Toppesfield	Castle	70	0	30	SE	136129			188492		
Lavenham -	Ridgewell	56	27	10	SW	121213	121213	E	205317	205316	N
Bulmer -	Steeple	34	1	50	NW	121214			205316		
Naughton -	Langham	2	52	7	SE	216543	216610	E	179186	179127	N
Stoke -	Steeple	60	22	7	SE	216690			179069		
Stoke -	Earles Colne	60	43	14	SW	159472	159471	E	164565	164565	N
St.Mary's,Colch.	Steeple	72	35	26	NW	159471			164565		
St. Mary's -	West Bergholt	51	8	42	NW	189552	189553	E	161393	161393	N
Great Tey -	Steeple	70	49	58	NE	189554			161393		
Danbury -	Braxted	36	18	45	NE	155021	155021	E	120989	120988	N
Great Tey -	Steeple	23	16	5	SW	155022			120988		
Braxted -	Kelverdon	11	32	29	NE	157104	157104	E	131184	131185	N
Great Tey -	Steeple	27	53	29	SW	157104			131186		
Great Tey -	Messing	2	21	21	SE	170301	170301	E	132010	132009	N
Kelverdon -	Steeple	86	25	29	NE	170302			132009		
Great Tey -	East Thorp	23	49	41	SE	175627	175627	E	140237	140236	N
Kelverdon -		93	57	29	NE	175627			140236		

Names of stations.		Bearings.			Distance from meridian.	Mean.		Distance from perpendicular.	Mean.	
		°	′	″	Feet.	Feet.		Feet.	Feet.	
Tiptree -	Witham Steep.	56	46	32 NW	143890	143888	E	120923	120927	N
Danbury -		21	52	28 NE	143887			120932		
Tiptree -	Tarling	75	58	23 NW	129390	129388	E	119511	119513	N
Danbury -	Steeple	2	3	23 NW	129386			119516		
Pleshey - -	Felstead	13	41	16 NE	98214	98210	E	138616	138613	N
Danbury -	Steeple	32	23	31 NW	98207			138611		
Pleshey -	Great Leigh	81	44	16 NE	118041	118041	E	122359	122361	N
Felstead -	Steeple	50	39	44 SE	118041			122363		
Pleshey -	Great Baddow	33	23	53 SE	114190	114191	E	87232	87229	N
Danbury -	Steeple	88	27	53 SW	114191			87226		
Pleshey -	Chelmsford	29	41	53 SE	107349	107349	E	94258	94263	N
Danbury -	Steeple	74	2	1 NW	107350			94288		
Danbury -	Whittle	82	41	29 NW	97251	97250	E	91931	91936	N
Pleshey -	Steeple	8	41	33 SE	97249			91942		
Gallywood -	Roxwell	43	43	26 NW	86985	86986	E	99902	99903	N
Pleshey -	Steeple	18	43	10 SW	86987			99905		
Gallywood -	White Roding	51	38	40 NW	59967	59967	E	116602	116604	N
Pleshey -	Steeple	86	15	55 SW	59967			116606		
Frierning -	Doddinghurst	78	55	28 SW	67638	67644	E	69301	69304	N
Southweald	Steeple	20	48	47 NE	67651			69308		
Southweald -	Theydon	54	3	14 NW	36122	36125	E	70851	70859	N
Epping Mill	Mount Steep.	65	23	14 SE	36128			70867		
Southweald -	Navestock new	4	50	14 NW	60484	60485	E	62217	62221	N
Theydon Mount	Mill	70	29	14 SE	60487			62226		
Southweald	Theydon Gar-	59	21	14 NW	29374	29363	E	71511	71461	N
Theydon Mount	non Steeple	85	20	14 NW	29351			71411		
Theydon Mount	Havering	16	39	44 SE	42172	42177	E	50654	50654	N
Theydon Garnon	Steeple	31	42	14 SE	42183			50654		
Severndroog	Cupola at	10	24	56 NW	4584	4584	E	47329	47331	N
Highbeech -	Woodford	10	4	28 SW	4584			47333		
Southweald	Ruins near	69	1	52 SW	13358	13357	E	34223	34225	N
Highbeech -	Ilford	9	1	28 SE	13356			34227		
Nasing -										
Berkhampstead	Hunsdon	5	57	9 NE	12836	12839	E	115758	115758	N
Gazebo -	Steeple	71	6	45 NE	12843			115758		
Huntsdon -	Broxbourn	40	38	9 SW	3021	3020	W	97376	97377	N
Nasing -	Steeple	88	37	51 NW	3020			97378		
Danbury -	Willingale	81	23	51 NW	70724	70725	E	96710	96713	N
Hatfield Oak	Spain Steeple	26	38	16 SE	70726			96716		
Danbury -	Braintree	5	52	1 NW	124508	124510	E	146272	146266	N
Felstead -	Steeple	73	47	14 NE	124513			146261		
Hatfield Oak										
Berkhampstead	Harlow Steep.	52	44	34 SW	33842	33846	E	111140	111081	N
Gazebo -		81	29	13 NE	33850			111023		
Hatfield Oak	Sabridgeworth	74	50	17 SW	34982	34959	E	121958	122044	N
Nasing -	Steeple	43	48	2 NE	34936			122136		

Names of stations.		Bearings.			Distance from meridian.	Mean.		Distance from perpendicular.	Mean.	
		°	′	″	Feet.	Feet.		Feet.	Feet.	
Albury -	Bishop Stortford	54	29	24 SE	35934	35929	E	143459	143454	N
Henham -	Steeple	40	22	56 SW	35925			143450		
Stanstead Mountfitchet Steeple	Farnham Steeple	79	27	59 NW	34427	34425	E	154725	154723	N
Henham -		69	37	6 SW	34423			154721		
Albury -	Stanstead Mountfitchet Steeple	84	18	27 SE	47531	47526	E	152294	152289	N
Henham -		29	34	6 SW	47522			152285		
Henham -	Meesdon Mill	69	20	30 NW	19158	19162	E	180479	180483	N
Albury -		1	6	40 NW	19167			180488		
Rickling -	Newport Steeple	41	50	8 NE	48409	48408	E	185013	185010	N
Elmdon -		45	1	52 SE	48407			185007		
Balsham -	ShudyCamps*	25	17	50 SE	82115	82114	E	217814	217818	N
Elmdon -		74	57	40 NE	82114			217822		
Shudy Camps	Ashdon Steeple	55	23	10 SW	68848	68848	E	208661	208660	N
Balsham -		5	49	20 SW	68848			208659		

Bearings of the principal Stations of the western Parts of Kent, &c. &c.

Frant -	Sevenoaks	19	20	53 NW	42962	42961	E	83270	83270	S
Botley Hill -	Mill	76	21	7 SE	42961			83271		
Frant - -	Chiddingstone	41	38	3 NW	33852	33850	E	106413	106403	S
Sevenoaks Mill	Steeple	21	31	57 SW	33848			106394		
Frant -	Mount Sion	6	35	46 NW	55693	55691	E	80967	80962	S
Chiddingstone		40	38	14 NE	55690			80957		
Frant -	East Peckham	24	52	44 NE	87147	87146	E	84966	84963	S
Mount Sion	Steeple	82	45	16 SE	87145			84960		
East Peckham	Tudeley	32	3	44 SW	73465	73465	E	106804	106803	S
Mount Sion	Steeple	34	31	16 SE	73465			106803		
Sevenoaks -	Seal Chart	65	21	5 NE	59674	59673	E	75602	75601	S
Botley Hill		87	22	55 SE	59673			75601		
Sevenoaks	Tunbridge Steeple	47	49	55 SE	63789	63789	E	102135	102135	S
Seal Chart -		8	48	55 SE	63789			102135		
Seal Chart	Otford Mount	36	37	55 NW	47503	47503	E	59233	59233	S
Sevenoaks -		10	42	5 NE	47503			59234		
Norwood -	Station, Well Hill	68	30	7 SE	34094	34093	E	45635	45636	S
Severndroog		25	45	47 SE	34093			45638		
Well Hill -	Crayford Steeple	9	14	45 NE	40174	40173	E	8287	8287	S
Severndroog		80	50	1 SE	40173			8288		
Crayford -	Ash Steeple	38	53	55 SE	68780	68780	E	43740	43741	S
Well Hill -		86	52	25 NE	68780			43742		
Gad's Hill -	Northfleet Steeple	69	4	54 NW	76615	76614	E	12548	12548	S
Halstow -		84	36	53 SW	76614			12549		
Sheppey -	Hern Hill	48	45	30 SE	220216	220216	E	60633	60633	S
Frinstead -		80	51	12 NE	220217			60633		
Hern Hill -	Stockbury Steeple	85	47	30 NW	148806	148806	E	55379	55379	S
Sheppey -		39	32	30 SW	148806			55379		
Sheppey -	Frinstead	15	23	54 SW	—	163132	E	—	698248	S

* Shady Camps, by mistake, in the former part of this Survey.

Bearings of the secondary and inferior Objects, &c. of the western Parts of Kent.

Names of stations.		Bearings.	Distance from meridian.	Mean.	Distance from perpendicular.	Mean.
		° ′ ″	Feet.	Feet.	Feet.	Feet.
Frant - -	Bidborough Steeple	16 51 0 NW	54785	54786 E	113503	113506 S
Botley -		53 21 9 SE	54787		113496	
Frant -	Station near Bidborough Church	20 46 3 NW	52687	52685 E	113000	112995 S
Chiddingstone		70 43 3 SE	52684		112991	
Botley - -	Tree near Kibben's Cross	57 9 11 SE	83513	83515 E	126687	126689 S
Frant -		60 56 36 NE	83518		126691	
Frant - -	Cowden Steeple	67 18 3 NW	23647	23679 E	122273	122270 S
Station near Bidborough Church		72 17 27 SW	23712		122268	
Station near Bidborough -	Leigh Steeple	15 18 3 NW	49720	49731 E	102152	102164 S
Mount Sion		15 39 57 SW	49742		102175	
Frant - -	Station, Ide Hill	31 32 33 NW	29621	29616 E	85152	85142 S
Chiddingstone		11 16 33 NW	29611		85132	
Ide Hill -	Eatonbridge* Steeple	38 26 27 SW	15562	15569 E	102848	102842 S
Chiddingstone		78 58 33 NW	15557		102839	
Mount Sion	Hadlow Steeple	62 9 16 SE	78053	78055 E	92775	92777 S
Peckham -		49 18 44 SW	78058		92779	
Otford Mount	Sundrich Steeple	49 33 5 SW	29901	29901 E	74241	74241 S
Seal Chart -		87 22 55 NW	29901		74241	
Well Hill -	Ketson Common Windmill	86 10 47 NW	7615	7614 E	43868	43867 S
Norwood -		54 24 45 SE	7614		43867	
Well Hill -	Hayes Common Flagstaff	82 24 47 NW	6068	6068 E	41903	41904 S
Severndroog		11 53 13 SW	6068		41905	
Hayes Common	Addington Common Flagstaff	84 34 43 SW	11919	11912 E	43611	43608 S
Norwood -		21 16 47 SE	11906		43606	
Well Hill -	Station, Farnborough	84 46 47 NW	22492	22491 E	44576	44576 S
Severndroog		11 47 47 SE	22491		44577	
Farnborough	St. Mary's Cray	15 41 13 NE	26553	26553 E	30116	30116 S
Well Hill -		25 54 47 NW	26554		30116	
Well Hill -	Halstead Steeple	31 47 27 SW	29536	29535 E	52990	52990 S
Norwood -		59 50 3 SE	29535		52990	
Norwood -	Bromley Steeple	85 1 7 SE	3304	3303 E	26574	26573 S
Severndroog		25 29 23 SW	3303		26572	
Bromley -	Hayes Steeple	6 39 47 SE	4441	4447 E	36311	36318 S
Well Hill -		72 33 47 NW	4453		36326	
Bromley -	Lewisham Steeple	19 48 37 NW	3352	3353 W	8096	8096 S
Severndroog		76 57 23 SW	3354		8097	
Chiselhurst -	New Cross	51 47 59 NW	9490	9490 W	3550	3550 S
Severndroog		88 43 59 NW	9491		3550	

* Edenbridge, by mistake, in the former part of this Survey.

Names of stations.		Bearings.				Distance from meridian.	Mean.		Distance from perpendicular.	Mean.	
		°	′	″		Feet.	Feet.		Feet.	Feet.	
Severndroog	Eastcombe	50	43	59	NW	86	86	E	7332	7332	S
New Cross	Point	41	21	1	NE	87			7332		
Severndroog	Woolwich	1	4	59	NW	13855	13853	E	5556	5556	N
Eastcombe Point	Steeple	82	38	59	SE	13852			5557		
Crayford	Bexley Steeple	41	21	39	SW	35426	35425	E	13679	13680	S
Severndroog		65	48	31	SE	35425			13681		
Well Hill	Charlton Farm	52	33	15	NW	15965	15965	E	31752	31751	S
Crayford		45	53	45	SW	15965			31751		
Crayford	Dartford Brent	69	26	13	SE	54059	54060	E	13496	13496	S
Ash	Mill	25	57	6	NW	54061			13497		
Ash	Hartley Steeple	29	56	5	NE	72706	72711	E	36922	36920	S
Northfleet		9	16	55	SW	72716			36918		
Ash	Ridley Steeple	64	4	45	SE	73446	73446	E	46009	46009	S
Northfleet		5	32	35	SW	73446			46010		
Gads Hill	Cliff Steeple	24	3	15	NE	113741	113741	E	5396	5396	S
Gravesend		70	49	7	NE	113742			5397		
Halstow	Gravesend	84	19	23	SW	84513	84517	E	12033	12058	S
Gravesend	Steeple	6	19	23	NW	84518			12082		
Halstow	Chalk Steeple	71	45	9	SW	96111	96110	E	18464	18462	S
Gravesend		74	54	24	SE	96109			18460		
Gads Hill	Guard Room, Lower Hope Point	3	41	11	NE	107247	107247	E	1895	1894	N
Gravesend		52	13	26	NE	107247			1894		
Gads Hill	Flagstaff, Tilbury Fort	52	58	28	NW	86260	86260	E	9039	9040	S
Gravesend		12	6	7	NE	86260			9041		
Sheppey	Rainham	62	21	39	SW	139485	139484	E	41373	41372	S
Gads Hill	Steeple	62	21	33	SE	139483			41372		
Halstow	Swanscombe	84	51	25	SW	70463	70463	E	12880	12879	S
Gads Hill	Spire	72	59	24	NW	70464			12879		
Halstow	Southfleet	75	19	30	SW	73187	73187	E	22234	22234	S
Gravesend	Steeple	59	50	13	SW	73187			22234		
Gravesend	Shorn Mill	61	26	17	SE	98017	98025	E	22580	22584	S
Halstow		64	12	53	SW	98034			22586		
Sheppey	Gillingham	78	54	49	SW	128724	128724	E	31425	31426	S
Halstow	Steeple	0	45	32	SW	128725			31427		
Gillingham	St. James's,	54	20	32	NE	163871	163871	E	6210	6209	S
Sheppey	Isle of Grain	37	57	19	NW	163871			6209		
Sheppey	Friendsbury	87	3	26	NW	115632	115631	E	18991	18991	S
Gads Hill	Steeple	65	10	37	NE	115631			18991		
Sheppey	Star Inn	71	18	17	SW	128656	128656	E	38221	38221	S
Halstow		0	43	10	SW	128656			38222		
Sheppey	Upper Bell Inn	62	18	51	SW	116532	116532	E	53454	53441	S
Halstow		15	16	0	SW	116533			53431		
Sheppey	Upchurch	63	9	35	SW	148260	148250	E	36283	36266	S
Gads Hill	Steeple	73	30	36	SE	148240			36251		
Frinstead	Hucking Spire	77	54	35	NW	147823	147822	E	66545	66545	S
Sheppey		32	37	45	SW	147822			66545		

Names of stations.		Bearings.	Distance from meridian	Mean.	Distance from perpendicular.	Mean.
		° ′ ″	Feet.	Feet.	Feet.	Feet.
Hern Hill -	East Church	34 30 32 NW	196669	196678 E	26283	26376 S
Sheppey -		78 12 36 SE	196688		26369	
East Church -	Milton Steeple	57 27 7 SW	169440	169445 E	43761	43758 S
Sheppey -		17 29 46 SW	169450		43754	
Milton -	Iwade Steeple	14 54 14 NW	165705	165702 E	29703	29685 S
Sheppey -		54 26 16 SW	165700		29667	
Hern Hill -	Witchling	73 23 12 SW	170790	170789 E	75380	75380 S
Frinstead -	Steeple	54 2 13 SE	170789		75380	
Hern Hill -	Sheldwich	56 6 30 SW	202302	202291 E	72667	72675 S
Sheppey -	Steeple	27 12 48 SE	202280		72682	
Sheldwich -	Queenborough	31 53 48 NW	170208	170213 E	21124	21128 S
Sheppey -	Steeple	80 52 4 NW	170219		21133	
Halstow -	St. Mary's	77 55 24 NE	135978	135977 E	6123	6123 S
Hadleigh -	Steeple	4 8 17 SE	135977		6123	
Hern Hill -	Feversham	77 56 30 NW	204931	204930 E	57368	57368 S
Sheppey -	Steeple	39 6 8 SE	204930		57368	

Latitudes and Longitudes of the preceding Stations and Objects, referred to the Meridian of Greenwich.

Names of stations.	Latitudes.	Longitudes.	Names of stations.	Latitudes.	Longitudes.
	° ′ ″	° ′ ″		° ′ ″	° ′ ″
Highbeech	51 39 42,5	0 2 8,3 E	Tiptree - -	51 47 2,2	0 41 17,8 E
Station, Hampstead -	51 33 55,4	0 10 28,0 W	Tillingham -	51 41 52,7	0 52 52,9 E
New Station, Wrotham -	51 18 55,5	0 18 49,2 E	Peldon -	51 58 50,3	0 53 11,4 E
Station, Gravesend - -	51 26 5,9	0 22 15,6 E	Flagstaff, St. Osyth Priory -	51 47 57,9	1 4 25,7 E
Langdon Hill	51 33 12,5	0 25 22,1 E	Great Tey -	51 53 53,2	0 44 49,9 E
Hadleigh -	51 32 52,5	0 35 7,4 E	Stoke -	51 59 20,4	0 53 22,6 E
Halstow - -	51 27 20,3	0 33 50,7 E	Thorp -	51 51 23,2	1 9 38,3 E
Gads Hill -	51 24 43,8	0 27 40,2 E	Little Bentley	51 52 56,3	1 4 49,7 E
Sheppey -	51 24 23,2	0 46 11,5 E	Dover Court	51 55 59,1	1 15 6,1 E
Rayleigh -	51 35 17,0	0 36 29,2 E	St. Mary's, Colchester -	51 53 17,7	0 53 33,7 E
Prittlewell -	51 32 56,2	0 42 16,2 E	West Mersea	51 46 29,8	0 54 33,3 E
Canewdon -	51 37 3,4	0 46 15,5 E	Little Bromley	51 54 43,4	0 39 16,8 E
Staff, Sheerness	51 11 21,6	0 44 25,7 E	Pattingstone	51 59 39,4	0 41 55,5 E
Danbury -	51 42 59,3	0 34 26,0 E	Rushmere -	52 4 7,3	1 12 0,8 E
Frierning -	51 40 32,5	0 22 7,0 E	Falkenham -	51 56 2,2	1 20 4,0 E
Purfleet Cliff -	51 28 59,4	0 14 9,9 E	Woodbridge -	52 5 34,6	1 18 36,8 E
South End -	51 32 4,4	0 42 15,5 E	Burley -	52 5 53,7	1 27 39,8 E
Staff, Shoeburyness -	51 31 19,1	0 47 12,6 E	Orford Light House -	52 5 0,1	1 34 13,6 E
			Otley -	52 8 54,1	1 13 2,5 E

Names of stations.	Latitudes.			Longitudes.				Names of stations.	Latitudes.			Longitudes.			
	°	′	″	°	′	″			°	′	″	°	′	″	
Henley - -	52	7	2,9	1	8	57,2	E	Flagstaff, East Tilbury -	51	27	36,0	0	25	49,2	E
Copdock -	52	1	51,9	1	5	13,2	E	Fobbing Steeple	51	31	39,8	0	28	30,7	E
Naughton -	52	6	3,5	0	56	56,7	E	Thundersley -	51	34	7,4	0	34	13,9	E
Twinstead -	51	59	48,4	0	42	47,2	E	Leigh - -	51	32	28,7	0	39	12,6	E
Lavenham -	52	6	19,1	0	47	27,0	E	Little Wakering	51	33	38,0	0	47	18,3	E
Bulmer - -	52	1	41,5	0	41	8,6	E	Bank Flagstaff	51	33	26,0	0	50	37,5	E
Glemsford -	52	6	8,8	0	40	36,4	E	Foulness Chapel	51	36	5,7	0	53	28,1	E
Toppesfield -	52	0	28,1	0	32	4,1	E	Tillingham Grange Signal							
Gallywood Common -	51	41	51,8	0	27	47,7	E	Staff - -	51	40	6,2	0	55	15,2	
Pleshey -	51	48	8.0	0	24	40,8	E	Flagstaff, Bradwell Point -	51	44	5,0	0	56	19,8	E
High Easter -	51	48	26,9	0	20	56,1	E	Brightlingsea	51	49	42,3	1	0	39,5	E
Hatfield Oak	51	49	35,5	0	14	37,4	E	Tolesbunt Major	51	45	57,2	0	45	49,5	E
Beauchamp Roding - -	51	45	48,9	0	17	8,8	E	Tolesbury -	51	45	27,6	0	49	54,9	E
Thaxted -	51	57	13,1	0	20	32,7	E	Althorn -	51	39	23,8	0	45	26,8	E
Southweald -	51	37	17,4	0	16	8,1	E	Burnham -	51	38	17,7	0	48	48,2	E
Brentwood -	51	37	11,8	0	18	9,5	E	Rettenden -	51	38	5,2	0	33	22,4	E
New Station, Highbeech -	51	39	42,9	0	2	1,1	E	Runwell -	51	37	15,6	0	31	53,4	E
Epping Mill	51	41	23,3	0	5	43,8	E	Great Burstead	51	36	13,6	0	25	31,2	E
Berkhampstead Gazebo -	51	45	23,0	0	7	23,3	E	East Hanningfield	51	40	11,4	0	33	10,2	E
Henham on the Mount -	51	56	1,7	0	14	45,7	E	Hockley -	51	36	34,9	0	38	6,3	E
Thorley -	51	50	53,8	0	8	33,2	E	Stow, St. Mary's	51	39	47,4	0	38	57,1	E
Elmdon - -	52	2	7,3	0	8	3,8	E	Stock Steeple -	51	39	40,0	0	26	19,3	E
Rickling -	51	57	40,3	0	10	51,2	E	Southminster	51	39	42,7	0	49	44,0	E
Albury - -	51	54	8,1	0	5	12,4	E	Layer Marney	51	49	13,7	0	47	42,6	E
Balsham -	52	7	56,1	0	19	9,6	E	St. Osyth Point Signal Staff -	51	47	3,0	1	8	46,5	E
Babraham Mount	51	32	38,5	0	12	52,1	E	Great Clackton Signal Staff	51	48	12,1	1	12	5,9	E
Triplow -	52	6	5,0	0	6	21,3	E	Frinton Steeple	51	30	26,8	1	12	28,4	E
Hornchurch -	51	33	37,3	0	13	36,1	E	Flagstaff, Frinton	51	50	17,8	1	15	33,4	E
Barking -	51	32	7,5	0	4	36,5	E	Walton Tower	51	51	51,2	1	17	6,8	E
Westham -	51	32	10,6	0	0	35,7	E	Cupola, Languard Fort -	51	56	18,5	1	19	3,9	E
Chigwell - -	51	37	27,2	0	4	53,4	E	Ardleigh -	51	55	34,3	1	59	1,5	E
Billericay -	51	37	32,5	0	25	6,5	E	Frating -	51	51	38,2	1	1	12,8	E
Public House	51	30	56,3	0	5	59,6	E	Thorrington -	51	51	10,0	1	3	19,4	E
Rainham -	51	31	5,7	0	11	29,0	E	Kirby - -	51	51	9.3	1	13	7,4	E
Belvidere -	51	29	11,7	0	9	55,3	E	Brantham -	51	57	56,4	1	4	15,5	E
Valence Tree	51	33	39,6	0	8	14,2	E	Harwich -	51	56	43,3	1	17	7,8	E
Cold Harbour	51	29	16,5	0	11	19,3	E	Little Oakley	51	54	37.3	1	12	45,9	E
Chadwell -	51	28	53,4	0	22	10,9	E	Bawdsey -	52	0	38.8	1	24	52,1	E
West Tilbury	51	28	26,1	0	23	27,7	E	Harkstead -	51	58	20.2	1	11	25,2	E
Greys Steeple	51	29	1,7	0	18	30	E	Arwarton -	51	57	56 8	1	13	42,9	E
West Thurrock	51	28	20,0	0	17	34,2	E	Bradfield -	51	56	2,2	1	6	56.5	E
Northfleet -	51	26	34,6	0	20	5,4	E	Orford -	52	5	40.9	1	31	54,2	E
Horndon -	51	31	25,7	0	24	17,8	E								

Names of stations.	Latitudes.			Longitudes.			
	°	′	″	°	′	″	
Nacton	52	0	34,5	1	13	34,6	E
Capel	52	0	10,6	1	2	6,9	E
Great Horksley	51	57	16,5	0	51	58,4	E
Mount Bures	51	57	27,8	0	46	11,7	E
Hollesley	52	2	48,7	1	25	38,4	E
Shottisham	52	3	5,2	1	22	50,8	E
Felixstow Staff	51	57	56,9	1	22	5,1	E
Bawdsey Signal Staff	51	59	39,8	1	24	36,6	E
Rendlesham	52	7	27,2	1	23	31,5	E
Kesgrave	52	7	14,9	1	14	2,2	E
Waldringfield	51	56	56,1	1	19	26,0	E
Whertstead	52	1	19,6	1	8	47,1	E
Hintlesham	52	2	59,4	1	2	27,3	E
Bildestone	52	1	50,5	0	53	40,0	E
Aldham	52	3	35,5	0	58	23,1	E
Hadleigh	52	2	34,5	0	57	0,7	E
Lindsey	52	5	40,5	0	52	58,9	E
Newton	52	2	9,1	0	47	47,4	E
Grotton	52	2	23,6	0	32	21,1	E
Waldingfield	52	3	35,1	0	47	13,7	E
Acton	52	3	31,2	0	45	31,7	E
Beauchamp	52	3	34,4	0	37	20,2	E
Hedingham Castle	51	59	35,6	0	36	7,6	E
Ridgewell	52	2	18,8	0	32	12,1	E
Langham	51	57	51,6	0	57	28,1	E
Earles Colne	51	55	34,2	0	42	15,6	E
West Bergholt	51	55	0,1	0	50	13,3	E
Braxted	51	48	25,5	0	40	58,4	E
Kelvedon	51	50	5,5	0	41	33,0	E
Messing	51	50	12,5	0	45	2,5	E
East Thorp	51	51	33,2	0	46	28,4	E
Witham	51	53	34,4	0	38	6,1	E
Tarling	51	48	13,0	0	34	11,7	E
Willingale Spain	51	44	31,6	0	18	40,0	E
Braintree	51	52	33,7	0	32	57,5	E
Felstead	51	51	23,3	0	25	59,2	E
Great Leigh	51	48	41,8	0	31	7,8	E
Great Baddow	51	42	55,8	0	30	7,2	E
Chelmsford	51	44	5,8	0	28	19,7	E
Whittle	51	43	43,4	0	25	39,6	E
Roxwell	51	45	2,3	0	22	57,7	E
White Roding	51	47	48,2	0	15	50,8	E
Doddinghurst	51	40	1,8	0	17	49,4	E
Theydon Mount	51	40	18,0	0	9	31,1	E
Navestock Mill	51	38	52,2	0	15	55,8	E
Theydon Garnon	51	40	23,6	0	7	44,2	E
Havering	51	36	58,7	0	11	6,1	E
Cupola at Woodford	51	36	26,5	0	1	12,3	E
Ruins near Ilford	51	34	17,3	0	3	30,7	E
Hunsdon	51	47	40,8	0	3	23,5	E
Broxbourn	51	44	30,8	0	0	47,8	E
Harlow	51	46	54,4	0	5	38,4	E
Sabridgeworth	51	48	42,5	0	9	14,4	E
Bishop Stortford	51	52	13,4	0	9	30,5	E
Stanstead Mountfitchet	51	53	40,2	0	12	35,1	E
Farnham	51	54	4,4	0	9	7,0	E
Windmill, Meesdon	51	58	18,5	0	5	4,9	E
Newport	31	59	2,5	0	12	50,6	E
Shudy Camps	52	4	24,2	0	21	49,9	E
Ashdon	52	2	54,7	0	18	17,6	E

West Parts of Kent.

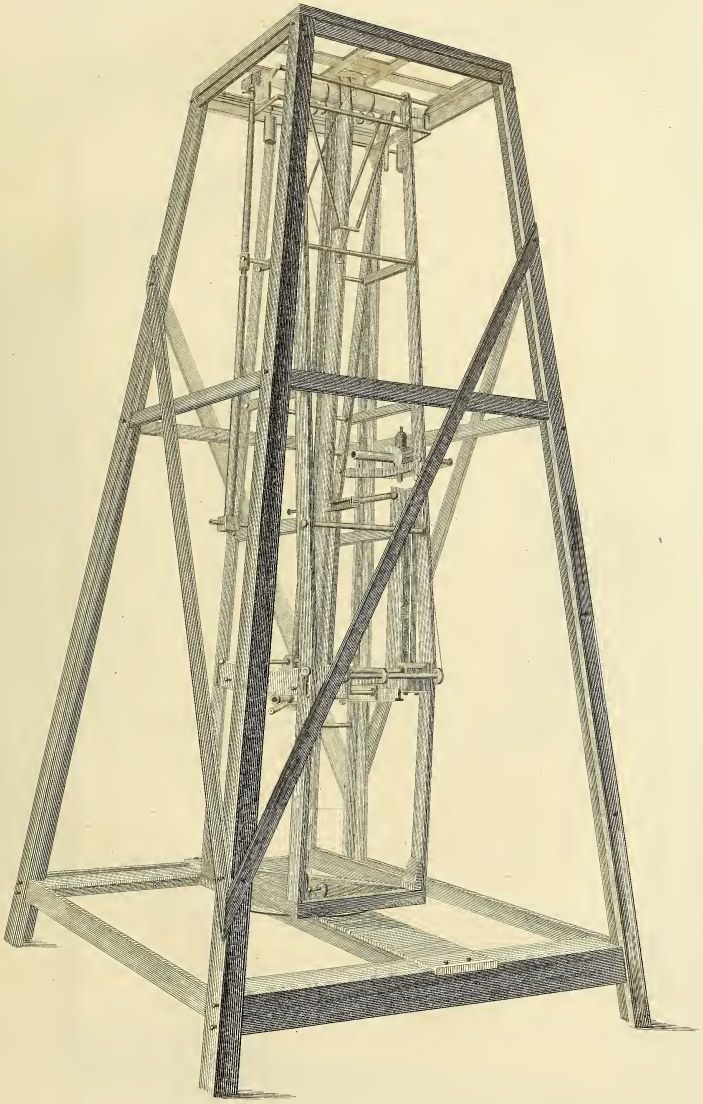
Windmill, Sevenoaks	51	14	58,5	0	11	12,9	E
Chiddingstone	51	11	10,6	0	8	49,6	E
Station, Mount Sion	51	15	20,8	0	14	32,6	E
East Peckham	51	14	40,1	0	22	45,2	E
Tudeley	51	11	6,0	0	19	9,4	E
Seal Chart	51	16	13,6	0	15	35,3	E
Tunbridge	51	11	51,6	0	17	1,6	E
Otford Mount	51	18	55,3	0	12	25,3	E
Well Hill	51	21	9,8	0	8	55,3	E
Crayford	51	27	17,8	0	10	32,2	E
Ash	51	21	26,9	0	18	0,2	E
Bidborough	51	10	0,3	0	14	6,8	E
Station near Bidborough Church	51	10	4,0	0	13	44,3	E
Tree near Kibben's Cross	51	7	48,8	0	21	45,1	E
Cowden Steeple	51	7	34,2	0	6	9,9	E
Leigh Steeple	51	11	51,8	0	12	58,3	E
Ide Hill	51	14	40,3	0	7	43,9	E
Eatonbridge	51	10	6,0	0	4	3,3	E
Hadlow	51	13	23,4	0	20	22,3	E
Sundrich	51	16	27,7	0	8	8,7	E
Windmill, Ketson Common	51	22	27,5	0	1	59,6	E
Hayes Common Flagstaff	51	21	46,9	0	1	35,3	E

Names of stations.	Latitudes.			Longitudes.				Names of stations.	Latitudes.			Longitudes.			
	°	′	″	°	′	″			°	′	″	°	′	″	
Addington Common Flagstaff	51	21	30,1	0	3	6,6	E	Rainham -	51	21	46,5	0	36	30,7	E
Farnborough	51	21	20,4	0	5	53,2	E	Southfleet -	51	24	59,4	0	19	10,7	E
St. Mary's Cray	51	23	42,9	0	6	57,3	E	Shorn Mill -	51	24	54,7	0	25	41,3	E
Halstead -	51	19	57,3	0	7	43,6	E	Gillingham -	51	23	27,4	0	37	3,0	E
Bromley -	51	24	17,8	0	0	51,9	E	St. James's, Isle of Grain -	51	27	36,9	0	54	6,9	E
Hayes - -	51	22	41,3	0	1	9,8	E	Friendsbury	51	25	29,0	0	30	18,4	E
Lewisham -	51	27	20,2	0	0	52,7	W	Star Inn -	51	22	18,5	0	37	1,1	E
Station, New Cross	51	28	5,1	0	2	29,3	W	Upper Bell Inn	51	19	49,2	0	30	28,9	E
Eastcombe Point	51	29	52,2	0	0	1,3	E	Upchurch -	51	22	36,1	0	38	49,2	E
Woolwich -	51	29	34,6	0	3	38,2	E	Bobbing -	51	21	13,6	0	42	34,0	E
Bexley -	51	26	24,8	0	9	17,3	E	Frinstead -	51	17	3,9	0	42	37,9	E
Charlton Farm	51	23	27,0	0	4	10,9	E	Hern Hill -	51	18	28,2	0	57	34,9	E
Dartford Brent Mill -	51	26	26,1	0	14	10,5	E	Stockbury -	51	19	27,6	0	38	55,3	E
Hartley -	51	22	34,5	0	19	2,3	E	Hucking -	51	17	37,6	0	38	38,3	E
Ridley -	51	21	4,9	0	19	13,3	E	East Church -	51	24	8,8	0	51	31,9	E
Cliff Steeple -	51	27	43,1	0	29	50,2	E	Milton -	51	21	20,3	0	44	21,0	E
Gravesend Steeple	51	27	39,2	0	22	9,7	E	Iwade -	51	23	39,5	0	43	24,4	E
Chalk Steeple	51	25	35,4	0	25	11,5	E	Witchling -	51	16	8,4	0	44	36,8	E
Guard Room, Lower Hope Point -	51	28	55,3	0	28	8,6	E	Sheldwich -	51	16	31,6	0	52	51,4	E
Flagstaff, Tilbury Fort -	51	27	8,8	0	22	37.4	E	Queenborough	51	25	3,4	0	44	36,5	E
								St. Mary's -	51	27	34,4	0	53	40,1	E
								Feversham -	51	19	2,3	0	53	35,7	E

In page 399, line 13, *for* G, *read g*.

——— 415, lines 5 and 6 from the bottom, *for* 430 revolutions, *read* 436.

——— 468, line 3, *for* 45 divisions, *read* 4,5.



GENERAL VIEW of the ZENITH SECTOR.

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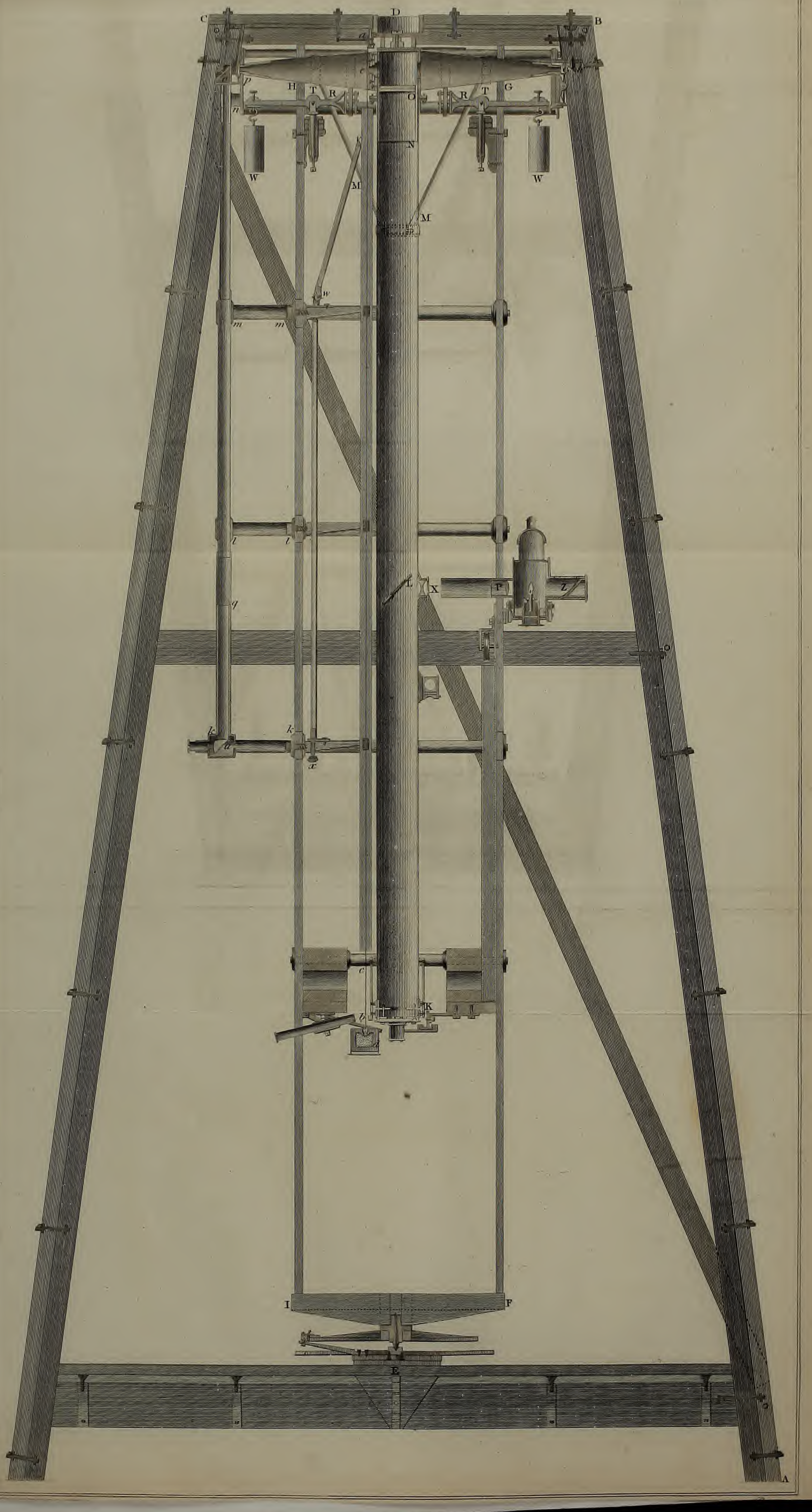
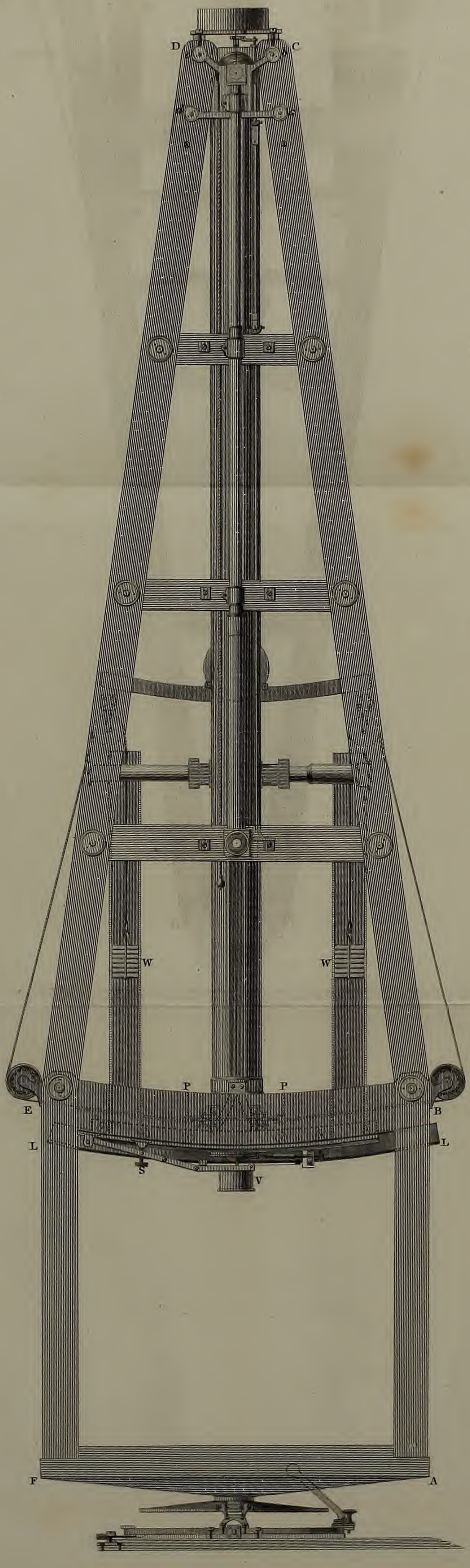
NATURAL HISTORY

SECTION *of the* ZENITH SECTOR *through the Plane of its* AXIS.



ELEVATION *of the Side of the Interior* FRAME *carrying the* ZENITH SECTOR.



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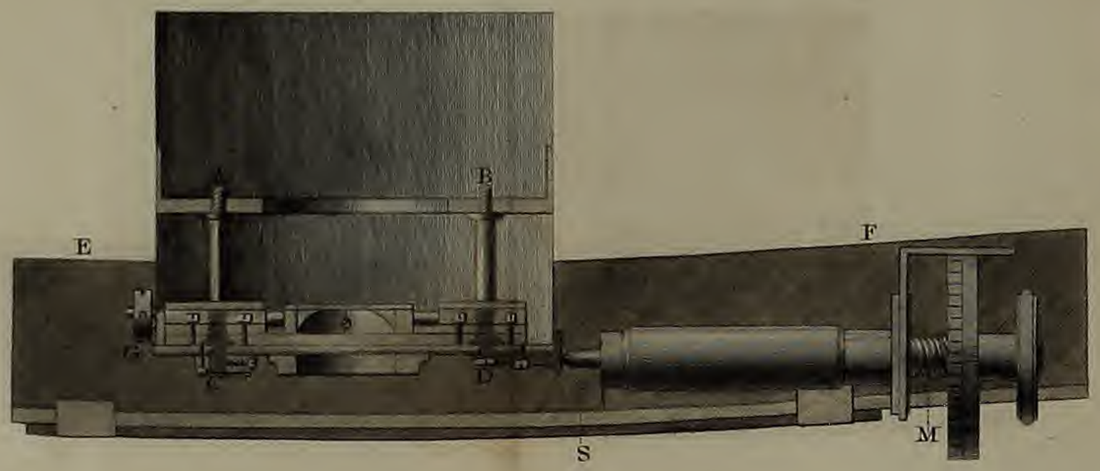
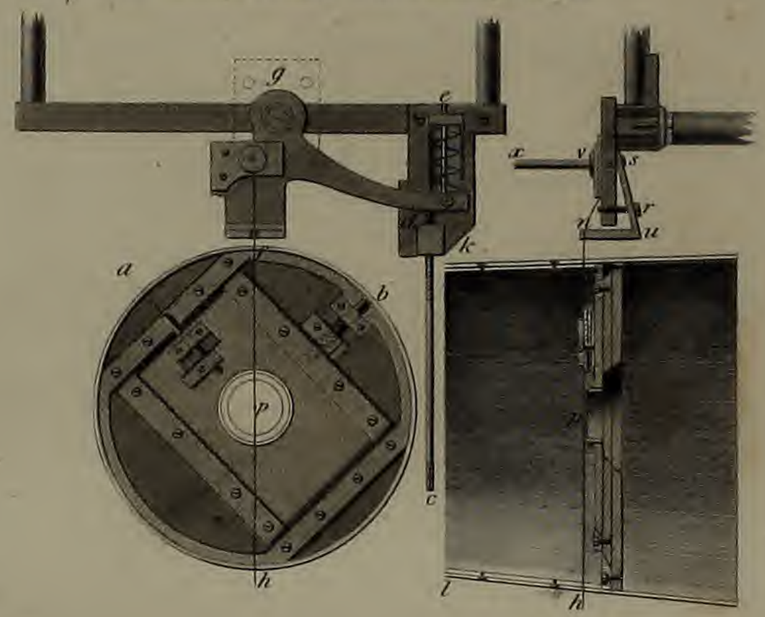
Section *of the Bottom of the* Telescope, *with its* Micrometer Screw.

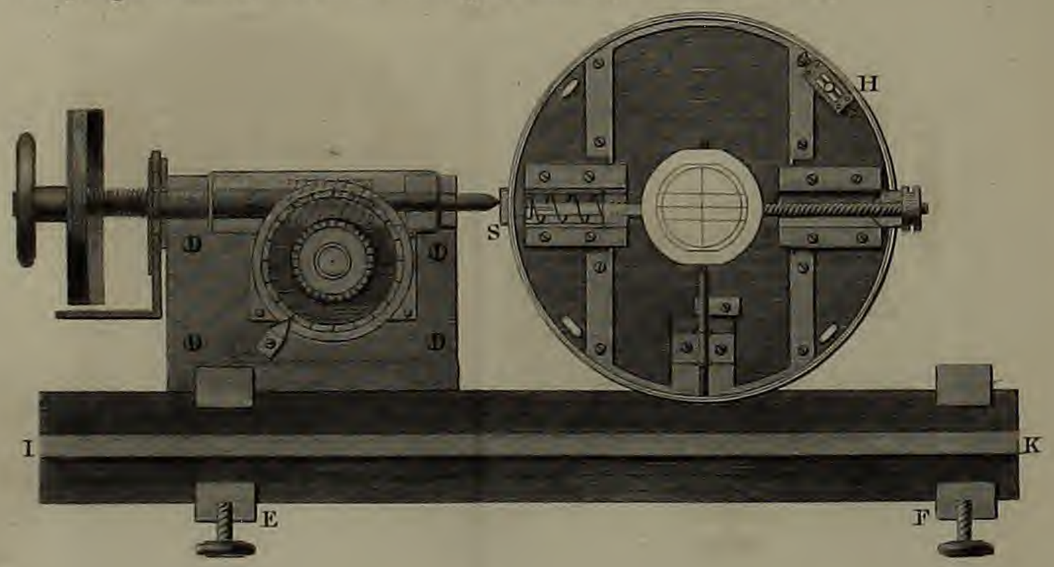


Section *of the* Diaphragm *Carrying the* Dot *also a* Section *of the* Axis *with the* Diaphragm.

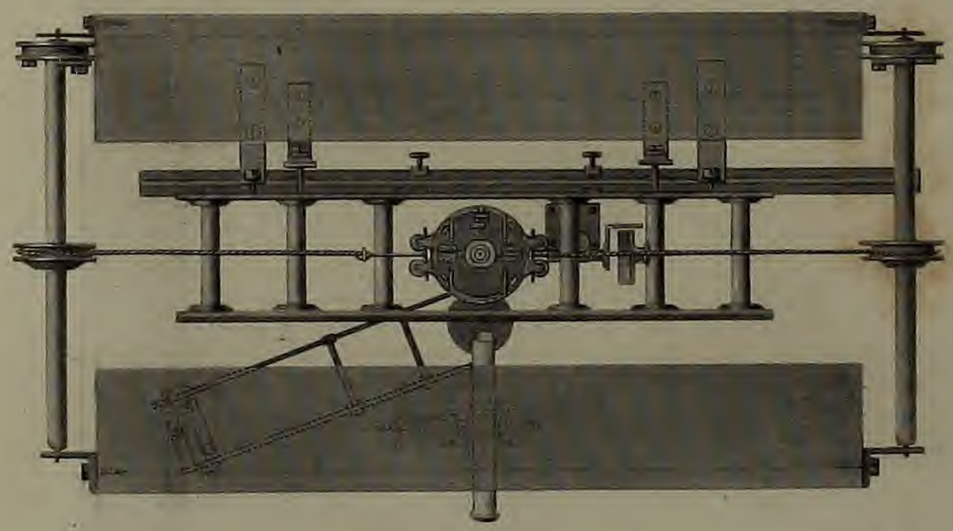


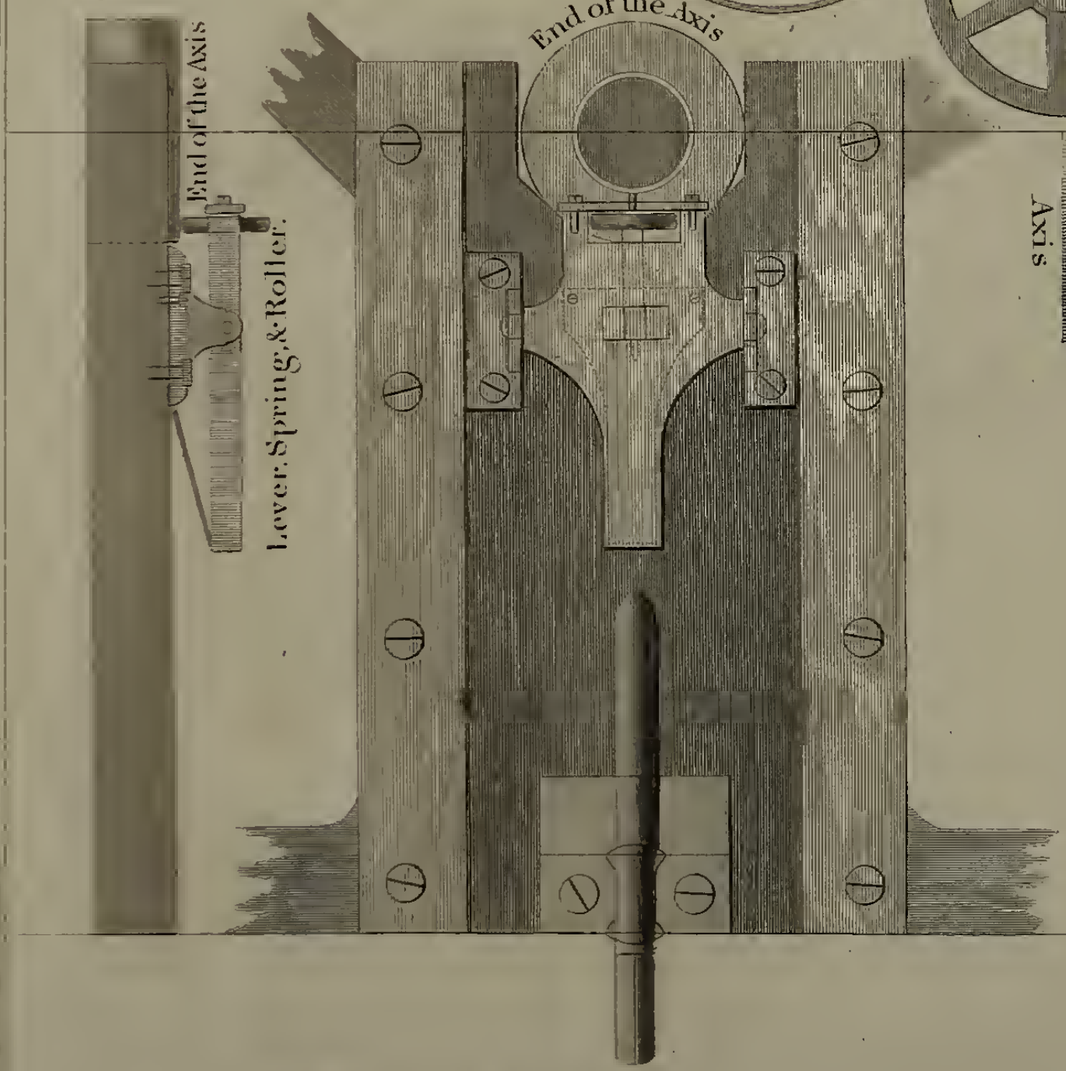
Horizontal View *of the Upper Part of the* Axis.

Horizontal View *of the End of the* Telescope, *with the Apparatus carrying the* Wires, *and also a view of its* Micrometer Screw.

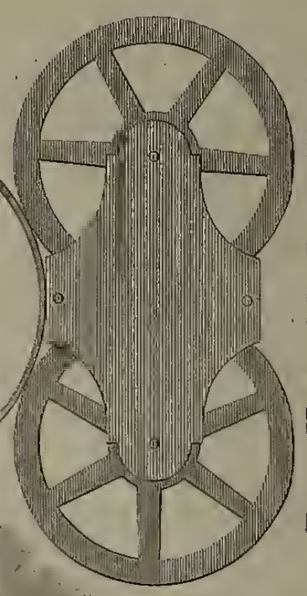


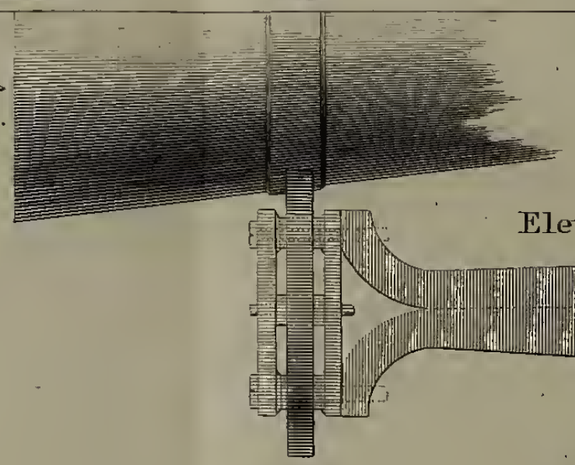
Horizontal View *of the* Axles, Pulleys *and* Arches.

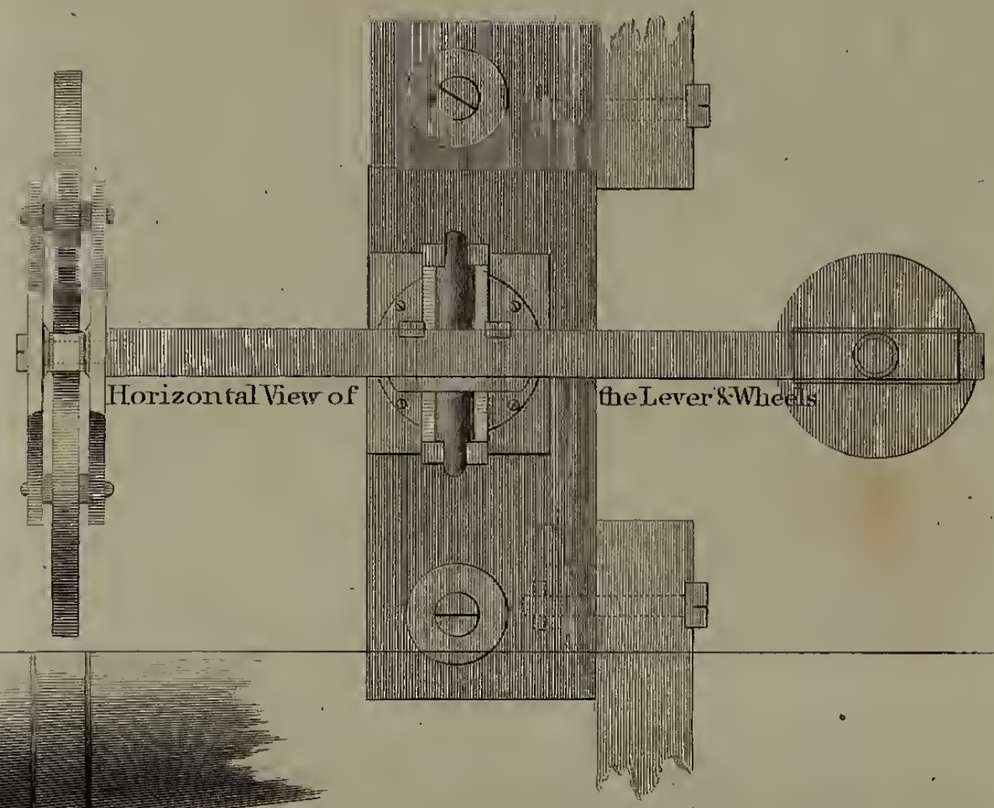


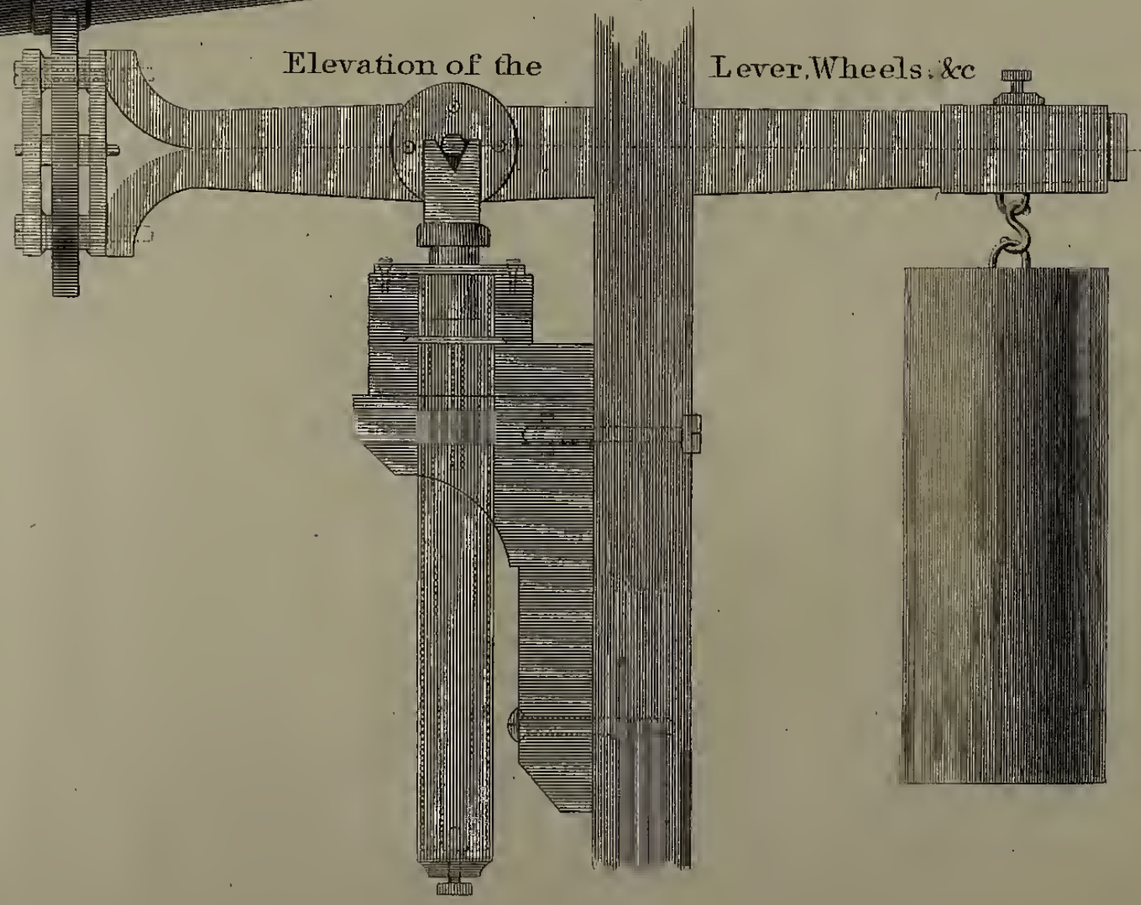


View of the ***PLATE*** carrying one of the Ys.









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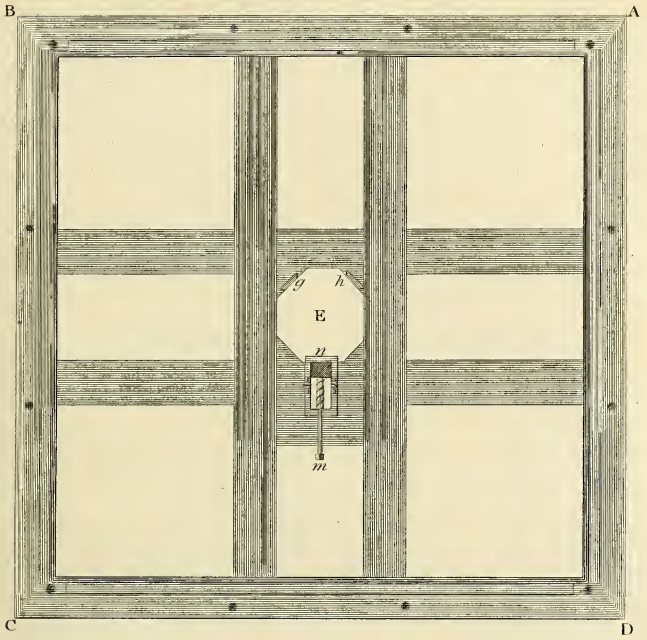
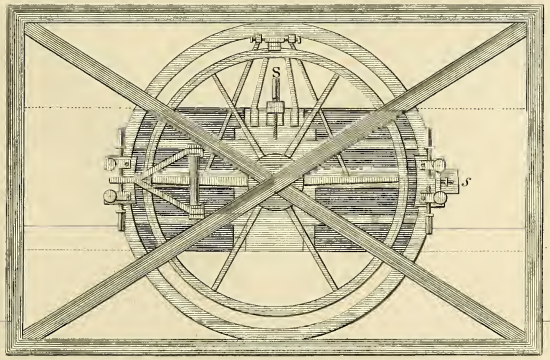
Top *of the External* Stand.



Bottom *of the Internal* Frame *resting on the* Azimuth Circle.



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TRIANGLES *for ascertaining the* Meridional Distance *between* CLIFTON *and* DUNNOSE.

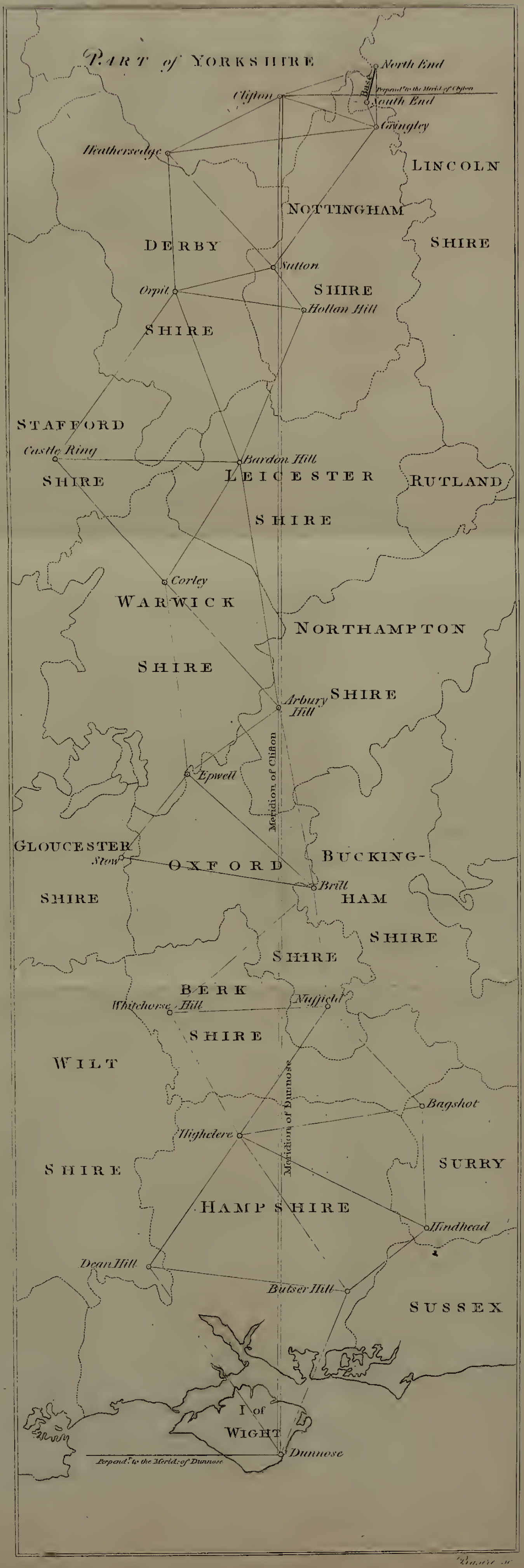


Fig. 1.

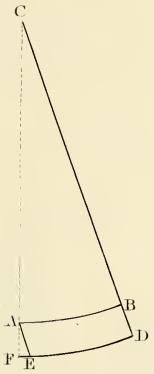
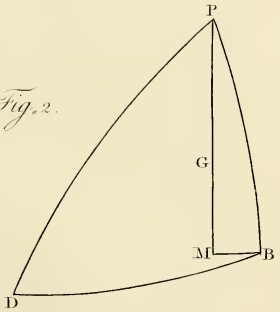


Fig. 2.



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